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BIOLOGICAL SURVEY—BULLETIN No. 34

C. HART MERRIAM, *Chief*

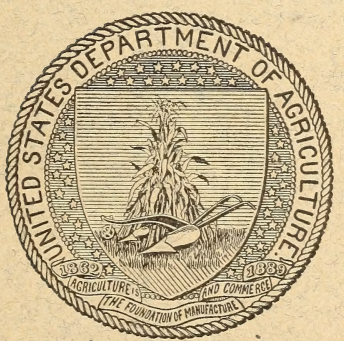
BIRDS OF CALIFORNIA

IN RELATION TO THE FRUIT INDUSTRY

PART II

By F. E. L. BEAL

Assistant, Biological Survey



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CALIFORNIA QUAIL

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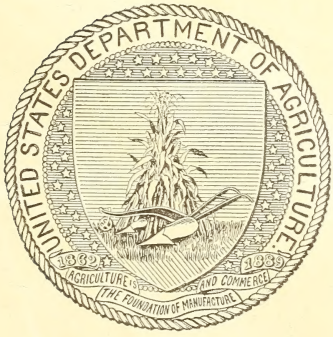

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Biological Survey,
Washington, D. C., February 25, 1910.

Sir: I have the honor to transmit herewith for publication as Bulletin No. 34 of the Biological Survey, Part II of the Birds of California in Relation to the Fruit Industry, by Prof. F. E. L. Beal. This, the final part of the report, treats of some of the most important California birds from the standpoint of the orchardist and the farmer. Careful study of the food habits of birds that frequent orchards and their vicinity shows that most of the species are beneficial, and that without their aid the difficulty and expense of raising fruit would be enormously increased; still a few species under certain circumstances are harmful and need to be held in check.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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BIRDS OF CALIFORNIA IN RELATION TO THE FRUIT INDUSTRY—PART II.

INTRODUCTION.

The first part of the report on Birds of California in Relation to the Fruit Industry was published in 1907. In addition to the linnet or house finch, which has attracted wide attention and is the subject of much complaint, 37 other species were discussed. In the present and concluding part, the food habits of 32 additional species are treated. Among them are some of the most important birds of the State, regarded from the standpoint of the farmer and fruit grower. The aim has been to collect all data possible on the food of the several species, to consider the facts impartially, and to render a just verdict as to the birds' economic relations.

All the birds whose food habits are discussed have direct relations with husbandry. It is true that many of them have not been charged with the destruction or injury of fruit or any other farm products. Almost all, however, destroy great numbers of harmful insects or devour seeds of noxious weeds; hence they are important economically.

A large part of the present report consists of statements concerning the food actually found in the stomachs of the birds. In this connection it should be borne in mind that by far the greater number of stomachs used in this investigation were collected in the more thickly settled and highly cultivated parts of the State, so that they probably contain a larger proportion of the products of husbandry than would a series of stomachs taken at random from all parts of the range of each species. It goes without saying that fruit and grain can be eaten only by such birds as have access to those products, while birds living in uncultivated places must subsist upon the fruits of nature.

Some California birds show a marked preference for oats, but in this State the presence of oats in a bird's stomach does not necessarily indicate that cultivated oats have been eaten, for wild oats cover hundreds of thousands of acres, and in the cultivated areas grow almost everywhere, affording a supply of food for many birds. Besides wild oats, the crop of volunteer oats that succeeds the cultivated crop is abundant and is to be found wherever this grain is

grown. In fact, in California the eating of oats can not as a rule be counted against a bird.

In no State in the Union is an accurate knowledge of the relations of birds to agriculture more important than in California. Climate and soil combine to make California an important grain and fruit producing State. The acreage already devoted to agriculture is large and is likely to increase for decades to come, as population increases and as new cultural methods are developed and irrigation is extended. Insects that now attract little attention are likely to increase and become serious pests. Certain birds formerly accustomed to a diet consisting partly of wild fruits, the supply of which is limited and likely to become smaller, will probably invade orchards and injure cultivated fruit. Hence it is worth while for the farmer and orchardist to learn as much as possible of the food of the birds that harbor near his premises, that he may know how much good each species does and how much harm, and so be enabled to strike a fair balance.

Some birds, like the swallows, swifts, wrens, and chickadees, are so strictly insectivorous that they are exceedingly beneficial. All they require at the hands of man in return for their services is protection. Others at some time of the year injure crops, though the damage by many is exceedingly small. Be the loss what it may, however, if a given species by its insectivorous habits prevents much greater destruction than it inflicts, the farmer should be willing to bear the loss for the sake of the greater gain.

Few birds are always and everywhere so seriously destructive that their extermination can be urged on sound economic principles. Only four of the species common in California can be regarded as of doubtful utility: These are the linnet, California jay, Steller jay, and redbreasted sapsucker. When the known methods of protecting fruit have been exhausted, or can not be employed profitably, then a reasonable reduction of the numbers of the offending birds is permissible. But the more the food habits of birds are studied the more evident is the fact that with a normal distribution of species and a fair supply of natural food, the damage to agricultural products by birds is small compared with the benefit.

A reasonable way of viewing the relation of birds to the farmer is to consider birds as servants, employed to destroy weeds and insects. In return for this service they should be protected, and such as need it should receive a fair equivalent in the shape of fruit and small grain. Nothing can be more certain than that, except in a few cases, any farmer who is willing to pay the toll collected by birds for actual services rendered will be vastly benefited. In the long run, no part of the capital invested in farm or orchard is more certain to pay big interest than the small sum required for the care and protection of birds.

CALIFORNIA QUAIL.

(*Lophortyx californicus* and *vallicola*.)

The California quail (see frontispiece) is common and generally distributed over the State west of the Sierra, except at the higher altitudes, and is especially abundant in the fruit-raising sections. Like the bobwhite of the East, this quail never goes far from cover, and it delights to dwell on unimproved land where trees and chaparral alternate with small areas of open ground. In settled regions it is somewhat domestic in habits and soon becomes accustomed to living in orchards, gardens, and cultivated grounds. The writer has seen a female sitting upon her eggs in a garden within 30 feet of a house, between which and the nest carriages and foot passengers passed many times each day. In winter a covey frequently feeds with the farmer's chickens, and if not disturbed will continue to do so until pairing time.

The natural food of the quail consists of the seeds of that vast group of plants known as weeds, with a little foliage of the same, especially in winter, when the leaves are young and tender. Considering how small is the amount of fruit usually found in the stomach of this bird, it is a surprise to learn that it sometimes does serious damage to vineyards. Investigation, however, shows that, as in most other similar cases, the injury results only when too many birds gather in a limited area. Nearly all the complaints against the quail for eating fruit are that it visits vineyards in immense numbers and eats grapes. When thousands visit a vineyard, even if only occasionally, and each bird eats or spoils at least one grape, the result is disastrous.

Mrs. Florence Merriam Bailey, writing of the foothills of San Diego County, says:

> In 1889 quail were so numerous that the dust of the roads was printed with their tracks, and it was an everyday matter to have them start out of the brush and run ahead of the horses quite unconcernedly, pattering along in their stiff, prim way, with their topknots thrown forward over their beaks. In fact, the quail were so abundant as to be a pest. For several years great flocks of them came down the canyons to Major Merriam's vineyard, where they destroyed annually from 20 to 30 tons of fruit. In one season, July to October, 1891, 130 dozen were trapped on his ranch. The result of this wholesale destruction was manifest when I returned to the valley in 1894. The birds were then rarely seen on the roads and seldom flushed in riding about the valley.[a]

Another observer states that he once saw a flock of about a thousand quail eating Zinfandel grapes in a vineyard in the central part of the State, and another says that in southern California he has seen as many as 5,000 feeding upon Muscat grapes. In the writer's interviews with California fruit growers, only one mentioned the quail

[a]Auk, XIII, p. 116, 1896.

as harmful. His ranch was situated along the hills on the side of a narrow valley, adjacent to wild grazing land with much chaparral and forest, among which the quail lived. In this case the annual loss was estimated at 2 or 3 tons of grapes.

In the laboratory investigation of the food of the California quail 619 stomachs were examined. They were collected in every month except May, but only one was obtained in March. The other months are well represented. Animal food, principally insects, amounts to but 3 percent, and most of this was found in the stomachs of young birds, mere broodlings. Vegetable food amounts to 97 percent and consists mainly of seeds of plants most of which are of noxious or troublesome species.

Animal food.—Ants appear to be a favorite food. They were found in 82 stomachs, and were eaten by adults as well as by young. They amount, however, to less than 1 percent of the whole diet. The rest of the animal food aggregates a little more than 2 percent and is distributed as follows: Beetles in 30 stomachs, bugs (Hemiptera) in 38, caterpillars in 11, grasshoppers in 7, flies in 2, spiders in 6, millepeds in 1, and snails in 2. The most interesting point in this connection was the stomach of a broodling only 3 or 4 days old. Besides several adult Hemiptera, some ants, caterpillars, and spiders, and a few seeds, it contained 280 minute insects, which constituted 76 percent of the stomach's contents, and were identified as an immature form of a species of scale, *Phenacoccus helianthi.*

In this connection the following extract from a letter dated at Los Angeles, Calif., October 28, 1908, by Dr. W. G. Chambers, to the Secretary of Agriculture is interesting:

> Last May during the hatching season one of my female quail died a week prior to completing the hatch. An incandescent light of 8 candlepower was substituted, the result being 15 baby quail, very wild at first, not understanding human sounds or language, but finally becoming as docile as pet chickens. They were raised in my back yard, running at large after the first week.
>
> A number of Marguerite bushes which grow in profusion in the yard were so infested with black scale that I had decided to uproot them and had postponed doing so, as the little quail worked so persistently among the branches; upon investigation I discovered them eating the scale and twittering happily; they would swallow the fully developed scale and thoroughly clean the branches of all those undeveloped.

The young in the first week of life eat animal matter to the extent of from 50 to 75 percent of the food, but by the time they are 4 weeks old they take little if any more animal food than the adults.

Vegetable food.—The vegetable part of the quail's food may be divided into fruit, grain, seeds, and forage. Fruit appeared in 106 stomachs, and aggregates 2.3 percent of the yearly diet. It was distributed as follows: Grapes in 7 stomachs, prunes in 9, apple in 3, Rubus (blackberry or raspberry) in 4, olive in 1, elderberry in 21, snowberry in 8, manzanita in 2, huckleberry in 11, and rose-haws in 3.

Pulp and skins, identified as fruit only, were found in 27 stomachs, and unknown seeds, probably those of some small fruit or berry, occurred in 10 stomachs. It is evident that the percentage of any one of the above is insignificant. Stomach examination throws no new light upon the quail's grape-eating habits, except to show that the ravages complained of are exceptional. That fruit does not constitute any important part of the bird's annual food is clearly proved.

Grain was found in 133 stomachs, and constitutes 6.4 percent of the food. It was distributed as follows: Corn in 14 stomachs, wheat in 15, oats in 13, barley in 89, and rye in 2. The principal complaints against the quail on the score of grain eating are that flocks sometimes visit newly sown fields, and eat large quantities of the seed. Walter E. Bryant says on this point:

> Two males which I shot one evening, as they were going to roost for the night, after having been feeding on a newly sown field, contained the following, mainly in the crop: (*a*) Two hundred and ten whole grains of barley, 6 pieces of broken barley, 3 grains of 'cheat,' and 1 of wheat, besides a few barley hulls, some clover leaves, and alfilaria; (*b*) one hundred and eighty-five whole grains of barley, 5 broken pieces, 4 grains of 'cheat,' and 2 of wheat; also barley hulls, clover, and alfilaria. The flock numbered nearly or quite 20 birds.[a]

Only one report accuses the bird of eating grain from the harvest field. Mr. W. T. Craig, of San Francisco, writing to the United States Department of Agriculture, says:

> I have observed the quail enter a field of wheat to the number of thousands, and had they not been driven away they would have destroyed the whole crop.

Stomach examination does not indicate any month in which grain is eaten in excess of other food. January shows the highest percentage, 12.4, but November is nearly as high, while December, although between the two, shows less than 3 percent. A little more than 3 percent was eaten in February, and none at all in March and April, though the newly sown grain would be accessible in one at least of these months. June and July, the harvest months, show respectively 4.1 percent and 10.7 percent. In fact the stomach record plainly indicates that the quail does not make special search for grain, but being naturally a seed eater takes grain when it comes in the way.

The seeds of a multitude of plants which have no apparent useful function except to increase by their decay the deposit of humus in the soil constitute the staff of life of the quail. In this particular investigation they aggregate 62.5 percent of the food of the year. They appear in stomachs taken in every month and reach a good percentage in each, the only months that show much diminution in quantity being January, February, March, and April, when new forage partly replaces seeds. The percentage is highest in June, 85.9, but shows no great falling off from July to December inclusive.

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[a] Zoe, IV, pp. 55–56, 1893–94.

Seventy-three kinds of seeds were identified, at least generically, and more than half of them were determined specifically. Many more were ground up so as to be unrecognizable. The following is a list of the seeds with the number of stomachs in which each kind occurred:

Poverty weed (*Iva axillaris*)	3
Gum weed (*Grindelia squarrosa*)	2
Bur marigold (*Bidens* sp.)	17
Sunflower (*Helianthus* sp.)	1
Tarweed (*Madia sativa*)	67
Mayweed (*Anthemis cotula*)	27
Milk thistle (*Silybum marianum*)	14
Thistle (*Cirsium* sp.)	5
Blessed thistle (*Cnicus benedictus*)	1
Bur thistle (*Centaurea melitensis*)	201
Sow thistle (*Sonchus asper*)	2
Sow thistle (*Sonchus oleraceus*)	1
Prickly lettuce (*Lactuca scariola*)	4
California dandelion (*Agoseris* sp.)	2
Blue vervain (*Verbena hastata*)	22
Stickseed (*Echinospermum* sp.)	16
Burweed (*Amsinckia tesselata*)	11
Ribwort (*Plantago lanceolata*)	2
Pursh ribwort (*Plantago purshi*)	1
Common plantain (*Plantago major*)	2
Painted cup (*Castilleia* sp.)	1
Black nightshade (*Solanum nigrum*)	10
Dodder (*Cuscuta* sp.)	3
Morning glory (*Convolvulus* sp.)	2
Pimpernel (*Anagallis* sp.)	2
Carrot (*Daucus carota*)	5
Lupine (*Lupinus* sp.)	150
Bur clover (*Medicago denticulata*)	156
Sweet clover (*Melilotus alba*)	6
Clover (*Trifolium* sp.)	75
Deer weed (*Lotus glaber*)	50
Vetch (*Vicia* sp.)	32
Five-finger (*Potentilla* sp.)	1
Turkey mullein (*Eremocarpus setigerus*)	168
Sumac (*Rhus laurina*)	69
Poison oak (*Rhus diversiloba*)	52
Alfilaria (*Erodium cicutarium*) Alfilaria (*Erodium moschatum*)	30
Carolina geranium (*Geranium carolinianum*) Common geranium (*Geranium dissectum*)	47
Wood sorrel (*Oxalis corniculata*)	1
Mallow (*Malva rotundifolia*)	11
Shepherd's purse (*Capsella bursapastoris*)	1
Peppergrass (*Lepidium* sp.)	5
Wild radish (*Raphanus sativus*)	5
Black mustard (*Brassica nigra*)	32
Wild turnip (*Brassica campestris*)	3
California poppy (*Eschscholtzia californica*)	1
Buttercup (*Ranunculus* sp.)	14

Water crowfoot (*Ranunculus aquatilis*)	3
Miner's lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	58
Pigweed (*Chenopodium album*)	11
Rough pigweed (*Amaranthus retroflexus*)	77
Corn spurry (*Spergula arvensis*)	1
Common chickweed (*Stellaria media*)	62
Field chickweed (*Cerastium arvense*)	2
Sleepy catchfly (*Silene antirrhina*)	58
Black bindweed (*Polygonum convolvulus*)	1
Dotted smartweed (*Polygonum punctatum*)	2
Common knotweed (*Polygonum lapathifolium*)	2
Wire grass (*Polygonum aviculare*)	55
Curly dock (*Rumex crispus*)	9
Sorrel (*Rumex acetosella*)	59
Sedge (*Carex* sp.)	26
Galingale (*Cyperus* sp.)	7
Rag grass (*Lolium perenne*)	56
Soft brome (*Bromus hordeaceus*)	3
Cheat, or chess (*Bromus secalinus*)	18
Walk grass (*Poa annua*)	29
Timothy (*Phleum pratense*)	1
Bear grass (*Stipa setigera*)	5
Canary grass (*Phalaris caroliniana*)	2
Unidentified seeds, mostly ground up	293

From this list it would appear that bur thistle, lupines, bur clover, and turkey mullein are the favorite seeds; that the others are not distasteful is shown by the quantities found in some stomachs. For instance, mayweed was identified in only 27 stomachs, yet one stomach contained at least 2,000 of these seeds; pigweed (*Chenopodium*) in but 11, yet one contained 1,000. One stomach held 83 kernels of barley, 592 seeds of geranium, 560 of tarweed, 40 of bur thistle, 48 of clover, 80 of alfilaria, 704 of timothy, 32 of catchfly, and 5 of snowberry, or 2,144 seeds in all. Another contained 1,696 geranium seeds, 14 bur thistle, 24 knotweed, 14 tarweed, 38 bur clover, 148 alfilaria, 12 ray grass, and 1 unknown seed, and a pod of uncertain origin—in all 1,944 seeds and a pod. In both cases the contents of the crop is included with that of the stomach or gizzard. These samples indicate considerable variety in the quail's diet, even in one meal.

Grass and other forage constitute a little over 25 percent of the quail's annual food. Forage amounts to less than 1 percent in June, remains about the same until October, and increases somewhat in November. In January it becomes important, and it reaches nearly 60 percent of the food for the next four months. The maximum, 85 percent, occurs in March; but this percentage, based on only one stomach, can not be considered final. Seeds and forage are practically complementary to each other—that is, as one increases the other decreases. June, which shows the least forage, has the largest percentage of seeds. Leaves of red and of bur clover and of alfilaria were the

favorite kinds, and in some cases constituted the whole stomach contents. Blades of grass are frequently taken. A few bits of acorn, and perhaps other nuts, were eaten, but the quantity is insignificant.

SUMMARY.

From the above analysis of the food of the California quail, it is apparent that under normal conditions the farmer and fruit grower have nothing to fear from its ravages. When, however, large areas of chaparral land are cleared and brought under cultivation, it is natural that the products of garden and vineyard should be eaten to a greater or less extent by quail, which abound in such localities. On the other hand, its seed-eating record is greatly in its favor. Usually there is little difficulty in getting rid of a superfluity of game birds; in fact, in most cases the trouble is to prevent their extermination. A bird so large, so easily trapped, so valuable as food, and withal one whose pursuit affords such excellent sport as the valley quail, will probably not become numerous enough to do serious damage except locally and under unusual conditions, and then a reduction of numbers is the easiest and simplest cure. Permits to trap quail on one's own premises are obtainable in California on application to the State fish commissioner. After the birds have been sufficiently reduced, they can be kept within reasonable limits by a moderate amount of shooting in the proper season.

WOODPECKER FAMILY.

(Picidæ.)

Among the useful birds of the State few take higher rank than the woodpeckers. They are mainly arboreal, and most of them may be designated as conservators of the forest in the strictest sense. The larvæ of certain species of beetles and moths live either under the bark or within the solid wood of trees, where they are safe from the attacks of birds, except such as are furnished by nature with special tools for digging into wood and bark. In this respect our native woodpeckers are in general highly favored. The peculiar structure of their chisel-shaped beak, combined with sharp claws and a stiffened tail for support, enables them, when they have located their prey, to drill down to it through several inches of wood and draw it forth with their tongue. This latter organ, in the more typical species of the family, is long, cylindrical, and barbed at the tip, being particularly well adapted for probing the burrows of boring insects.

Twenty-one species and subspecies of woodpeckers occur in California. Of these about half a dozen are sufficiently abundant and widely distributed to be economically important. The average

amount of insect food in the stomachs of the six species discussed in the following pages is 62 percent of the whole contents.

It is unfortunate that the most valuable species of our woodpeckers are not abundant. In many parts of the country the downy and hairy woodpeckers are quite rare and, what is worse, appear to be diminishing in numbers. As they are among the most valuable of our species, it is worth while to inquire into the cause of their scarcity and if possible to devise efficient remedies. In most sections these birds can obtain an abundance of food, and as they are not persecuted, so far as known, the most probable cause for their scarcity would appear to be the lack of suitable nesting sites. This is especially true in the northeastern part of the United States where the war waged upon the gipsy and brown-tail moths has led to the trimming of all dead trunks and limbs from forests and orchards, so that the woodpeckers, which as a rule dig new nesting holes every year, are left with no places in which to nest. In Germany, after much experimentation, it has been found possible to construct nesting boxes which the European woodpeckers freely use. There can be no reasonable doubt that a similar result can be attained in this country. Pending experiments and as a step in the right direction, it would be well for orchardists to leave the stubs of dead limbs on orchard trees as sites for the nests of woodpeckers. While the woodpecker may use the nest it excavates only one season, the hole will be available for bluebirds, wrens, chickadees, and nuthatches in succeeding years. The experiment of inducing our woodpeckers, especially the downy and hairy, to build in artificially constructed nesting boxes is well worth patient and persistent experiment.

HAIRY WOODPECKER.

(*Dryobates villosus harrisi* and *hyloscopus*.)

Two subspecies of the hairy woodpecker occur in California, and between them they occupy nearly the whole State at some time of the year. Their favorite haunts are open groves and orchards, and as forests disappear and fruit trees increase in number, they will probably more and more inhabit orchards. That the hairy woodpecker is far from abundant at present is unfortunate, for its food habits make it of great economic importance. Only 27 stomachs have been examined, but the dates of collection are well distributed. Seven is the greatest number taken in any one month (September), and none at all were obtained in March, May, August, and October. While this number is sufficient to afford a general idea of the kind of food the bird prefers, it does not furnish reliable data as to the relative proportions of the different constituents.

Of the contents of the 27 stomachs, 78 percent consisted of animal matter, nearly all of which was either insects or spiders. The remaining 22 percent was made up of various vegetable substances. In the relative proportions of animal and vegetable food the California bird differs somewhat from the eastern subspecies, the diet of which consists of 68 percent of animal matter to 32 of vegetable.

Animal food.—Of the various items in the food of the western hairy woodpecker, the most important, as well as the largest, is the larvæ of wood-boring beetles (Cerambycidæ and Buprestidæ). These aggregate for the year nearly 49 percent of the total. This is a much greater proportion than is eaten by the eastern subspecies, and is probably not exceeded by any other bird. Each of several stomachs contained more than 20 larvæ. When the immense damage done by these borers to forest trees, as well as to orchards, is considered, it is hardly possible to overestimate the value of this woodpecker's services. Moreover, these insects are concealed and protected from the attacks of all birds except those of this family. Most of these insects are taken in the cooler months, the fewest being eaten in July. One stomach taken in February contained 70 percent of wood-borers, and the remainder, or 30 percent, consisted of other harmful beetles. Two stomachs taken in April contained an average of 76 percent of these destructive borers and 6 percent of other beetles. Beetles belonging to various families, nearly all of them harmful, and some very injurious, amount to over 9 percent of the food.

Ants are usually a favorite article of food with woodpeckers, but with the California hairy woodpeckers they constitute less than 3 percent of the year's food. This is somewhat surprising, as the eastern bird eats them to the extent of 17 percent. Other Hymenoptera, including wasps, amount to less than 2 percent.

Caterpillars exceed 11 percent, and stand next to beetles in importance. Many of them are of wood-boring species and evidently were dug out of trees.

A few miscellaneous insects and some spiders complete the animal food. Several stomachs contained segments of millepeds, or thousand legs, and one held the remains of one of those bristly creatures known as jointed spiders (Solpugidæ).

Vegetable food.—The vegetable part of the diet may be divided into fruit, seeds, and miscellaneous substances. Fruit amounts to 6 percent, and consists of the smaller kinds, probably mostly wild species. Rubus seeds (raspberry or blackberry), found in several stomachs, were the only fruits positively identified. Seeds aggregate nearly 12 percent, and all that were determined belonged to coniferous trees. The miscellaneous part contains a little mast and some cambium, or inner bark, but is mostly rubbish, such as rotten wood, probably swallowed accidentally with the beetle larvæ.

SUMMARY.

The above brief review of the food of the hairy woodpecker indicates that nearly half its yearly food consists of larvæ of some of the most destructive insects known, while this service is not offset by the destruction of any useful product. The other elements of the bird's food are either beneficial or neutral. It is unfortunate that the species is not more abundant on the Pacific coast.

DOWNY WOODPECKER.

(*Dryobates pubescens gairdneri* and other subspecies.)

To the ordinary observer the downy woodpecker is only a miniature edition of the hairy, which it resembles in everything but size. It seems, however, to be far more abundant than its larger relative, especially in California. It is much more domestic than the hairy, and frequents orchards and gardens and the vicinity of houses. Its food consists of the same elements but in different proportions. The following report is based on an examination of 80 stomachs, taken in every month of the year. The food consists of 77 percent of animal matter to 23 of vegetable, thus agreeing closely with the diet of the hairy.

Animal food.—The animal food is composed of insects, with a few spiders. The western downy eats 16 percent of wood-boring larvæ, a little more than the eastern downy, but less than one-third as much as the hairy woodpecker. Other beetles amount to 13 percent. They are mostly harmful species, the exception being a few Carabidæ, or predaceous ground beetles.

Ants are eaten to the extent of 12 percent, which is less than half the quantity taken by the eastern subspecies. While ants may sometimes subserve a useful purpose, they are for the most part annoying or noxious. It is well known that they protect and foster plant lice, and they often injure timber by boring galleries through it, frequently beginning in the abandoned burrow of a beetle larva. In houses they are an unmitigated nuisance, and in gardens and lawns are often equally obnoxious. For these reasons the habitual destruction of ants by woodpeckers is commendable. Other Hymenoptera amount to less than 2 percent, and consist of wasps and wild bees.

The largest item in the food of the downy is made up of caterpillars, pupæ, and a few adult moths. These aggregate a little over 21 percent. Pupæ of the codling moth were identified in 4 stomachs and the larvæ in 2, of which one contained 16 entire full-grown larvæ. Another held the remains of 20 of these pernicious insects. From investigations during the past few years it appears that birds constitute a most efficient natural check to the spread of this destructive moth, especially such birds as woodpeckers, titmice, nuthatches, and creepers, which obtain much of their food from crevices in the

bark of trees. It behooves the orchardist to see that these birds are carefully protected on his premises and encouraged in every possible way.

The Hemiptera, or bugs, which appear in the food of the downy woodpecker are plant lice and scales, with a few other forms. They amount to 10 percent of the year's food, but all were eaten in the seven months beginning with March, and averaged 17 percent for each of these months. Scales were found in 8 stomachs, and in one they constituted 83 percent of the contents. The black olive scale (*Saissetia oleæ*) was the only one identified. Plant lice were found in 11 stomachs, but none were specifically identified, although some were of the woolly species. That these are a favorite food is shown by the quantity eaten. Five stomachs contained the following percentages: 94, 94, 84, 81, and 80. These creatures are so fragile that the process of digestion soon destroys their shape, and it is highly probable that small numbers were contained in many more stomachs but were not identified.

Grasshoppers, although a favorite article of bird food, are entirely ignored by the downy woodpecker. This emphasizes the arboreal habits of this species, as most birds feed upon grasshoppers, when in season, in preference to their ordinary food. Flies also are practically absent from the diet of the downy. A few miscellaneous insects and spiders, amounting in all to 3 percent, make up the remainder of the animal food.

Vegetable food.—The vegetable part of the food may be arranged under three heads—fruit, seeds, and miscellaneous items. Fruit was found in 14 stomachs, and amounts to 9 percent of the food. Cherries were identified in a few stomachs, and apples, or a similar fruit, in several more; but most of the remains were skins of small berries not further identified. Evidently this bird does little or no damage to fruit. Seeds amount to a little more than 7 percent, and are mostly those of poison oak, which the downy, in common with many other birds, aids in disseminating. Grain (oats) was found in 2 stomachs. The miscellaneous vegetable food, 7 percent, consists of mast, or acorn meat, a little cambium, and rubbish.

Food of young.—A nest of young downies was watched for 12 one-hour periods during six days, and the number of feedings noted as follows:

Date.	Hours in forenoon.	Number of feedings.	Hours in afternoon.	Number of feedings.
June 7	9.16–10.16	12	4.23–5.23	13
June 8	8.01– 9.01	10	1.13–2.13	10
June 9	10.42–11.42	12	5.00–6.00	10
June 10	9.17–10.17	14	2.34–3.34	10
June 11	10.15–11.15	11	4.49–5.49	15
June 12	10.37–11.37	20	4.33–5.33	23

In the twelve hours during which the birds were watched, the nestlings were fed 160 times, an average of 13⅓ times per hour; or each of the 4 was fed more than three times per hour. The nest was in a stub of a cherry tree in a mixed orchard, and apparently all the foraging was done in the immediate vicinity, as food was brought too often to have been carried any great distance; moreover, the parent birds were frequently seen searching the trees. Both parents took part in caring for the young, one often waiting patiently near by while the other fed the nestlings. At first the parent birds entered the nest chamber when they came with food, but later, as the nestlings grew larger, they remained outside, thrusting their heads in at the opening. The food nearly always appeared as a white mass in the beak, which led to the suspicion that the young were being fed with woolly aphids. The parent birds came from the direction of a number of apple trees which were badly infested with this pest, and the bark of the trees showed places from which the insects had been recently taken. Thus it was practically certain that aphids were being fed to the young woodpeckers.

SUMMARY.

From the foregoing account it is evident that the downy woodpecker is of great value to the horticulturist. Its food consists largely of orchard pests, and its levies upon fruit are insignificant. The orchardist should note that the downy makes its nest in a chamber which it excavates in a partly rotten trunk or limb of moderate size, frequently of an apple tree. Where such wood occurs in or about the orchard, it should be left for the convenience of the woodpecker and his successors, the wrens and titmice. By so simple a precaution as this the number of downies and of other useful birds that build in holes may be materially increased in an orchard and their services secured without cost at the very point where most needed. When trimming dead limbs, it is necessary only to leave a few inches of the stub, which is not unsightly, and which answers all the purposes of the woodpecker.

NUTTALL WOODPECKER.

(*Dryobates nuttalli.*)

The Nuttall woodpecker is well distributed over California west of the Sierra Nevada, but is less abundant than the downy and not quite so domestic. It is rather more fond of big oaks and other forest trees than of the orchard, but is often found on fruit trees.

The following analysis of its food is based upon the examination of the contents of 46 stomachs, taken in various parts of the State and in every month except May. The first division of the food into

animal and vegetable matter gives 78 percent of the former to 22 percent of the latter, exactly the same as in the case of the hairy woodpecker.

Animal food.—Of the animal food, beetles are the largest item, and amount to nearly 34 percent. They consist largely of larval Cerambycidæ, or borers. While not so good a driller for insects as the hairy, the efforts of the Nuttall are not to be despised. It destroys a goodly number of wood-borers, but it eats more adult beetles of other families than do either of the species whose food has been discussed. A considerable number of small leaf beetles (Chrysomelidæ) are eaten by the Nuttall, and are probably taken from leaves. It eats also click beetles (Elateridæ), darkling beetles (Tenebrionidæ), and weevils (Rhyncophora), among which the genus *Balaninus*, that preys upon acorns and other nuts, was identified. A few predaceous ground beetles (Carabidæ) were found.

Ants do not appear to be a favorite food of this woodpecker, and they were eaten very irregularly. They constituted 36 percent of the food in June, 22 percent in September, and appear in small quantities in January and August, but are completely wanting in the other months. The average for the year is less than 6 percent. Other Hymenoptera form practically the same percentage, but nearly all were contained in a single stomach taken in December.

Hemiptera (bugs), like ants, are taken very irregularly and occur either in considerable quantities or not at all. In January they amount to 46 percent of the food of the month, in February to 28 percent, in June to 10 percent, in July to 36 percent, but in the other months do not appear. The average for the year is 11 percent. They belong to several families, but no special pest is prominent. Scales were found in two stomachs and plant lice in one. Three stomachs contained remains of the box-elder bug, *Leptocoris trivittatus*, of which two stomachs contained between 30 and 40 specimens each. This bug is very abundant in some places at times, and injures the box-elder tree. It has also done some damage to fruit.

Diptera (flies) were found only in the stomachs taken in June. They amounted to 12 percent for that month or 1 percent for the whole year.

Caterpillars stand next to beetles in the quantity eaten by the Nuttall woodpecker. They amount to over 13 percent of the food, and, except in the three winter months, appear very regularly. Many of them are of the wood-boring kinds, but leaf-eaters also are present. Various other insects, insects' eggs, and a few spiders amount to 7 percent, and complete the animal food.

Vegetable food.—Fruit amounts to 11 percent, or half of the vegetable food. Naturally most of it was taken during the summer and fall months, although the one stomach taken in December contained

35 percent of fruit pulp not further identified. The greater part of the fruit eaten is of wild species, of which the elder (*Sambucus*) is the favorite. Rubus fruits (raspberry or blackberry) were found in a few stomachs. Probably this bird will never do any serious harm by eating fruit. Seeds of poison oak, cambium, and mast (acorns) make up the other 11 percent of the vegetable food, and have no special economic interest, except that the scattering abroad of the seeds of poison oak is a nuisance. Taken as a whole, the vegetable food of the Nuttall is of little economic importance.

SUMMARY.

While the evidence at hand does not show that this bird feeds on any specific pest, yet it is doing good in preying upon noxious insects in general; moreover, it does not injure any product of husbandry. It should therefore be encouraged to pursue its good work.

RED-BREASTED SAPSUCKER.

(*Sphyrapicus ruber.*)

While the red-breasted sapsucker inhabits most of California at some time of the year, it is generally absent from the valleys during the warmer months, usually retiring to the mountains and forest regions to breed.

Of the 24 stomachs of this species received, nearly all were taken in fruit-growing sections, and represent only the months from September to March inclusive. Statements based upon the examination of so little material can scarcely be considered final, but considerable knowledge may be gained of the kinds of food eaten, even if the relative quantities can not be determined. The food consists of 63 percent of animal matter and 37 percent of vegetable.

Animal food.—Seventy-five percent of the animal food consists of ants, and the average per month is 40 percent of the whole diet. Two stomachs taken in January contained an average of 49 percent each. One stomach collected in March held 84 percent, and one in September was completely filled with them. In other months the amounts were less. In respect to ant eating this sapsucker keeps up the reputation of the family. Other Hymenoptera aggregate only a little more than 7 percent, and all were found in stomachs taken from October to December inclusive.

This bird, like its eastern relative, has the habit of removing patches of bark from certain live trees, usually willows, for the sake of cambium and of the sap which exudes; and it also eats the insects attracted by the sap, which are mostly bees, wasps, and ants; probably this accounts for the large predominance of Hymenoptera in the sapsucker's diet.

Beetles amounted in January to 3.5 percent, in November to 1.4 percent, in December to 0.7 percent, with none at all in the other months. The average for the whole year is only 0.8 percent. No larvæ of wood-borers were found, and apparently this bird never aids the hairy woodpecker in the good work of destroying these creatures. The species eaten were mostly small leaf beetles (Chrysomelidæ), with a few weevils.

Hemiptera (bugs) and Diptera (flies) were entirely wanting in the stomachs examined. Caterpillars were present in two stomachs, both taken in October. They amounted to 5 percent of the food of that month. One stomach taken in February was entirely filled by a large centipede.

Vegetable food.—The vegetable part of the food of the red-breasted sapsucker falls naturally into three divisions—fruit, seeds, and other vegetable matter. As the bird is not present in the fruit-growing sections of the State when fruit is ripe, it can not make great inroads upon the orchard. While fruit aggregates nearly 17 percent, it is mostly wild or of worthless varieties. Figs, whose seeds and pulp were found in one stomach, were the only cultivated kind identified. Several stomachs contained berries of the pepper tree (*Schinus molle*), one contained cascara berries (*Rhamnus californicus*), and in several were unidentified seeds and pulp. Seeds amount to about 9 percent, and are those of the poison oak, with a few others. The miscellaneous item is made up almost entirely of cambium, or the inner bark of trees, and amounts to about 11 percent of the whole food.

SUMMARY.

It is evident that the red-breasted sapsucker falls far below some other members of its family in economic importance. It does not prey upon the worst pests of the orchard and forest, but on the other hand it does not feed on the products of the orchard or farm. It injures trees by tapping holes in the bark and by stripping it off in patches, for which reason this sapsucker may be considered more harmful than beneficial.

CALIFORNIA WOODPECKER.

(*Melanerpes formicivorus bairdi.*)

The California woodpecker is distributed throughout a large part of the State, but is in the main confined to places where there is an abundance of large oaks—trees for which it appears to have a special liking and from which it derives much of its subsistence. Wherever it lives it is usually abundant and the most noticeable element of the bird fauna, attracting attention both by its loud cries and by its conspicuous flight. It is one of the few woodpeckers whose food is more largely vegetable than animal.

Of all the woodpeckers the California has made most impression on nonscientific observers, owing to its peculiar habit of drilling holes into the trunks and branches of dead trees or into the bark of living ones, in each of which it stores an acorn. Wherever the bird is abundant every dead trunk or large branch is punctured with holes, frequently less than an inch apart. So zealous is it in this work that when trees are not available it often drills holes in cornices, church spires, telegraph and telephone poles, and fence posts. The woodpecker does not get the benefit of all its hoarded acorns by any means, for jays, rats, mice, and squirrels have learned where they can obtain food in winter, and are not backward in helping themselves to the woodpecker's stores. As this robbery of his larder is resented by the owner, it leads to endless quarrels.

For the laboratory investigation of the food of the California woodpecker 75 stomachs were available. They were taken in every month except February, April, and May, the greater number in June and July, when the bird's chances to do mischief are greatest. The food consists of 22.43 percent of animal matter to 77.57 percent of vegetable. This is the highest percentage of vegetable matter yet found in the stomach of any woodpecker, though the red-bellied (*Centurus carolinus*) comes very close to it.

Animal food.—Beetles constitute the smallest item of the animal food. They amount to less than 3 percent, and are distributed among several families. The only month in which they are at all prominent is July, when they reach nearly 15 percent. No wood-boring larvæ were found. This would seem to indicate that the bird uses its chisel-shaped bill solely for the purpose of boring holes in which to store acorns, instead of excavating for insects.

Ants amount to 8.21 percent of the food. In one stomach taken in March they constitute 50 percent of the contents, but in no other do they reach 11 percent. The specific name of this bird, *formicivorus*, ant-eating, is not well chosen, for ants do not form a large part of its diet as compared with several other woodpeckers. Other Hymenoptera amount to 6.88 percent. More than half of these were in stomachs taken in August, when they aggregate 33 percent.

A few bugs, flies, and grasshoppers, with fragments of caterpillars, make up the remainder of the animal food, 4.52 percent. One stomach contained a few black olive scales.

Vegetable food.—Grain, fruit, and mast constitute nearly the whole of the vegetable food. One stomach taken in January contained nothing but corn, and another in December contained a few corn hulls. This is the whole of the grain record, and is of no economic interest. The average for the year but slightly exceeds 1 percent. Fruit amounts to a little more than 24 percent, and was found in nearly every month in which stomachs were taken. Most of it was evidently

the pulp of the larger cultivated varieties, though that in the stomachs taken in winter could have had no economic value. Seeds of the elderberry (*Sambucus*) were found in two stomachs. The largest amounts of fruit were eaten in August and September, when they reached 59.34 and 54 percent, respectively. While this is a high percentage of fruit, it is not believed that the bird does any sensible damage in the orchard, since it is not numerous enough and does not usually frequent cultivated ground. No complaints of such damage have yet been heard.

The principal item of food of the California woodpecker is acorns. Acorns form 52.45 percent of the year's food, and were found in every month when stomachs were taken except August; as only three were collected in that month, the record is not very reliable. In November, when 12 stomachs were taken, mast amounted to nearly 93.58 percent of the average contents. In 12 stomachs collected in June, when fruit and insects are abundant, it averaged 79.25 percent. In July it fell to 29.47 percent, the deficiency of acorns being made up by animal food, which attains the highest percentage in that month. The question has been raised whether the woodpecker stores acorns for the sake of the meat, or for the grubs that frequently develop therein. Stomach examination shows that, while the substance of the acorn is eaten freely whenever obtainable, larvæ are almost entirely wanting. It is therefore the nuts themselves that the woodpecker stores for food. From an economic point of view little objection to this acorn-eating habit can be raised. The acorn crop is usually superabundant, and in most cases can not be put to better use than to tide the woodpeckers over the winter until insects become plentiful.

SUMMARY.

From the foregoing discussion of the food of the California woodpecker it is obvious that the bird's food does not possess high economic value. On the other hand the bird can not be charged with the destruction of useful insects or of any product of husbandry. While it eats some fruit, it does not habitually infest orchards, and is seldom numerous enough to be a serious nuisance. The few insects it eats are nearly all harmful.

The trees used by the bird for storehouses are usually dead or partly so, and in living trees the punctures do not go through the bark, so that no harm is done. When holes are drilled in buildings, fences, or telegraph poles, the injury is real, but on the whole the damage done in this way is not extensive.

When the beneficial and injurious habits of the bird are carefully weighed, the balance is decidedly in the bird's favor; and from the esthetic standpoint few birds are more interesting and beautiful.

RED-SHAFTED FLICKER.

(*Colaptes cafer collaris.*)

In food habits the flickers of California do not differ essentially from their eastern relatives. They are usually abundant wherever there are trees, and are frequenters of orchards, though they usually choose higher trees for nesting sites. They are among the most terrestrial of the woodpeckers, and obtain a large part of their food on the ground.

For the investigation of the flicker's food 118 stomachs, taken in all months except January and May, were available. In these stomachs animal food amounts to 54 percent and vegetable to 46 percent.

Animal food.—Beetles, in either adult or larval form, do not appear to be favorite food with the flicker. They amount to 3 percent of its diet, and are apparently eaten to a small extent in every month. In August they amount to 8 percent, in November to 7, and in all other months the percentage is small. They belong to 6 families, all harmful except the predaceous ground beetles (Carabidæ). These occurred in 33 stomachs, but the percentage in each case was small, and they seem to be taken only incidentally. Weevils were found in 4 stomachs, click beetles in one, darkling beetles in 6, rove beetles in 3, and *Notoxus alamedæ* in one.

Ants constitute the largest item of the flicker's food, and are eaten in every month. They are the object of the bird's search on the ground and in rotten logs and stumps. The average for the year is 45 percent, the same as was found in 230 stomachs of the eastern flicker. The stomach and crop of one individual of the eastern form taken in Texas was filled with over 5,000 small black ants (*Cremastogaster*). Each of several California stomachs held more than 1,000 of these insects, and others but few less. In 10 stomachs taken in June the average percentage of ants was 76; in 10 taken in July, it was 87 percent. November was the month of least consumption, when the average of 34 stomachs was 7 percent. Of the 118 stomachs, 78, or 66 percent of the whole, contained ants, and 14 held nothing else, except a little rubbish in three, and in one a few seeds of filaree (*Erodium*). Inasmuch as certain ants in California, in the latter part of summer, make a business of harvesting seeds, probably this particular woodpecker had picked up a few ants that were thus employed. Hymenoptera other than ants are eaten by the flicker only occasionally, and average less than 1 percent of the yearly food.

Miscellaneous insects amount to nearly 5 percent. They consist of common crickets, wood crickets, mole crickets, caterpillars, white ants (*Termes*), spiders, and sow bugs (*Oniscus*). All of these suggest

decaying logs and stumps, where the flicker obtains a large share of its food.

The following insects and crustaceans were identified in the food of the flicker:

COLEOPTERA.

Amara insignis.
Anisodactylus dilatatus.
Anisodactylus piceus.
Calathus ruficollis.
Platynus maculicollis.
Harpalus sp.

HYMENOPTERA.

Formica neorufibarbis.
Cremastogaster lineata.
Lasius sp.
Messor andrei.
Solenopsis geminata.
Prenolepis imparis.

CRUSTACEA.

Porcellio scabra.
Oniscus sp.

Vegetable food.—The vegetable food of the flicker includes many items. They may, however, be grouped under four heads: Mast, grain, fruit, and other vegetable food. Mast forms 10 percent of the food. It is taken fairly regularly, but in the greatest quantity in winter. It was contained in 15 stomachs, 1 holding nothing else. In one case it was English walnut, but in all others it appeared to be the meat of acorns. December showed the maximum amount, 40 percent. Grain was found only in stomachs taken in August, October, and November, the highest percentage being in August, about 17 percent. The total for the year was only 4 percent. It was all contained in 16 stomachs, and consisted of corn in 14 cases, barley in 1, and oats in 1. A stomach taken in November was entirely filled with corn. It is not likely, however, that the flicker ever does serious damage to corn or any other grain. The examinations do not indicate any great fondness for this food, and observation has never shown that the bird makes a practice of visiting grain fields.

Fruit was found in 39 stomachs, in 26 of which it was thought to be of cultivated varieties, but in the other 13 it was wild. Apples, cherries, grapes, prunes, and probably pears were the domestic fruits identified. One stomach was entirely filled with apple pulp and another practically so. Grapes are apparently the favorites. The wild varieties of fruit identified were pepper berries, elderberries, and gooseberries. Fruit pulp that could not be further determined was found in several stomachs and was classified as domestic, although it may have been wild. The aggregate of fruit for the year is 15 percent. While no complaints have been lodged against the flicker for depredations upon fruit, evidently it can do serious damage where it is abundant. It enjoys living in orchards or their immediate vicinity, and, as the stomachs show, does not hesitate to sample their products, but it eats most of its fruit in the latter part of the season, after

cherries, apricots, peaches, and prunes have been gathered. September is the month of greatest consumption, 48 percent. Fruit is taken quite regularly during the rest of the year; but only 6 percent was eaten in June, the month of cherries, and 7 percent in July, the month when apricots are at their best, and none in August, the month of peaches and prunes. The damage done to fruit by the flicker probably consists in spoiling a few choice specimens, rather than in extensive destruction of the crop.

Various other substances make up the remaining vegetable food of the flicker, 17 per cent. Of these the most conspicuous is the seed of poison oak (*Rhus diversiloba*). These noxious seeds were found in 41 stomachs, and 1 was entirely filled with them. Very few are eaten in June and July, but they form an important article of diet through the fall and winter. The month of greatest consumption is October, when they constitute 40 per cent of the total food. The consumption of these seeds would be a decided benefit to man if they were ground up and destroyed in the stomachs. Unfortunately they are either regurgitated or pass through the intestinal tract uninjured and ready to germinate. The action of the stomach simply removes the outer covering, a white, wax-like substance, which is probably very nutritious, and is evidently relished by many birds. Birds are probably the most active agents in the dissemination of these noxious shrubs. On the other hand, these seeds, which are wonderfully abundant, afford food for thousands of birds during the winter, when other food is hard to obtain, and thus enable the birds to tide over the cold season to do their good work of destroying insects the next summer. Seeds of a nonpoisonous Rhus, some weed seeds, and a little rubbish were found in a few stomachs.

The flicker of California, and probably of the west coast in general, has one habit not observed in the eastern species. The mild climate and abundant food supply render migration unnecessary, but, like many other birds that nest in holes in trees, it likes shelter during the winter nights. As trees in which cavities can be made are not numerous enough, it pecks holes in buildings, as barns, schoolhouses, and churches. It often happens that the hole leads into the interior of the building and so proves useless to the bird, and it makes another and another till it hits the right place—in the cornice, for instance. Usually several holes are made before suitable shelter is found, and the consequent disfigurement and damage are sometimes serious.

SUMMARY.

In summing up the food of this flicker, two points are important—the destruction of ants and the eating and consequent scattering of the seeds of poison oak. The destruction of ants is a benefit, but it does not appeal to the horticulturist and farmer as does the destruction of well-known pests. While people are often annoyed by ants,

they seldom suffer much damage by them. However, though ants do not destroy fruit or other crops to any great extent, they aid and abet other insects which do considerable harm. This is particularly true in regard to plant lice, which are housed, protected, and generally cared for by ants. Ants also continue the destructive work in timber begun by beetle larvæ until the wood is rendered worthless. The other insects eaten by the flicker are all more or less harmful, except a few useful ground beetles (Carabidæ). Most of the vegetable food is neutral; the amount of fruit and grain destroyed is not sufficient to constitute serious injury, but the scattering broadcast of the seeds of poison oak is harmful. As on the whole the flicker does more good than harm, it should be protected and encouraged.

OTHER WOODPECKERS.

Several other species of woodpeckers inhabit the State of California but, excepting the Lewis woodpecker, they are neither so numerous nor so generally distributed as those already treated. Their food consists in the main of the same elements, although the proportions vary with the species. The Lewis woodpecker (*Asyndesmus lewisi*) is perhaps the most important of these species, but since only 23 of its stomachs are available for examination, a definite statement of its food during the year can not yet be made. It appears to eat rather more vegetable than animal food, and in fall and winter eats large quantities of acorns. In the selection of its animal food it resembles the flicker in showing a decided taste for ants and other Hymenoptera.

Dr. C. Hart Merriam contributes the following note on this species:

The Lewis woodpecker is one of the commonest and most widely distributed woodpeckers of California, in these respects coming next after the California woodpecker (*Melanerpes formicivorus bairdi*). But owing to its habit of breeding at higher altitudes it is less often seen in the lower and more highly cultivated parts of the State, except during migration. It breeds mainly in the Ponderosa pine forests of the mountains (Transition zone), whence, usually in early September, it descends into the blue oak and Digger pine belt of the foothills to spend the winter.

Like the California woodpecker, it is a skillful flycatcher, pursuing and capturing insects in mid-air. But in fall and winter its principal food is acorns, of which it eats surprising quantities. At this season is is usually seen in small flocks of from 6 to 20 birds, each carrying a large acorn in its bill.

These woodpeckers are very fond of ripening apples, and in early September descend in flocks upon the orchards, particularly those of the higher foothills, and in certain cases, if let alone, destroy practically all the fruit. I have heard of their depredations in various parts of the State and have personally seen the birds, in early September, circling about the orchards and diving down into the apple trees between Round Mountain and Montgomery Creek, and in Fall River Valley, Shasta County, and in Scott Valley and the upper canyon of Klamath River near Beswick, in Siskiyou County. At the latter place they are so destructive that during the ripening of the fruit gunners employed to shoot them frequently kill 25 in a day, and in early September, 1907, I was told that as many as 50 had been killed in one day.

While, as stated above, our investigations have not proceeded far enough to enable a final statement to be made regarding this woodpecker's economic status, enough is known to justify the belief that the bird, by its destruction of insects the year round, is much more beneficial than injurious, despite its occasional depredations on apples and other fruit.

The sapsuckers of the genus *Sphyrapicus* have been accused of doing much harm by boring into fruit and other trees for sap, and while the charge is well founded the injury is largely counterbalanced by the bird's destruction of insects. The sapsuckers are not numerous enough, however, to be reckoned an important factor either way.

FLYCATCHER FAMILY.

(Tyrannidæ.)

Among our useful birds the flycatchers (Tyrannidæ) take high rank. As is well known their principal food consists of insects captured in mid-air. If the name flycatcher implied that these birds subsisted largely upon flies (Diptera), it would be a misnomer, for nearly all the species eat far more Hymenoptera than Diptera. In fact wasp-catcher would be much more appropriate. The name, however, is intended to suggest the idea that the birds are flying when they catch their prey. The capture of food in this way implies that the species are strong, rapid flyers, and capable of making quick turns in the air. In addition to flying insects, the flycatchers eat spiders and other wingless forms and some vegetable food which they pick up from the ground or snatch from trees. The animal food of the 6 species discussed in the following pages averages 90 percent of their diet.

Several flycatchers in the eastern part of the country are quite domestic in their habits and frequent orchards and gardens, and some species nest about buildings. In California some of the corresponding species have not yet become so accustomed to the presence of man and his works, but they are learning rapidly. The black phoebe is perhaps as familiar there as is the common phoebe in the East; but the kingbird of California has not fully decided that the orchard is a safe and altogether desirable place for nesting purposes. Sixteen species and subspecies of flycatchers have been found within the limits of this State. Six of them are numerous enough to be of economic importance.

ASH-THROATED FLYCATCHER.

(*Myiarchus cinerascens.*)

The ash-throated flycatcher is a summer resident of the lower and warmer parts of the State. Its habit of nesting in cavities perhaps causes it to seek the vicinity of farm buildings, where such accommodations are numerous. It builds in hollow trees also, which may often

be found in the older orchards. The eastern species (*M. crinitus*), which nests in hollow trees, habitually places the shed skin of a snake in the walls of its nest. The reason for this is not plain, but the writer has never seen or heard of a nest in which the snake skin was lacking. The ash-throat occasionally does the same thing, but apparently does not consider the snake skin indispensable. Though an orchard bird, it seldom eats any cultivated fruit, but confines its diet largely to insects, most of which are either injurious or neutral.

In the following investigation of the ash-throat, 80 stomachs were used, collected from April to December inclusive, but only one in each month after July. Animal food amounts to 92 percent and vegetable to 8 percent for the season. Stomachs taken in April, May, August, October, and November contained no vegetable food whatever. The one stomach taken in September held 44 percent of elderberries, which is exceptional. A greater number of stomachs in this month would probably have reduced this percentage considerably.

Animal food.—Of the animal food, beetles, almost entirely of harmful species, amount to 5 percent. The two families most prominent in the food are the longicorns (Cerambycidæ) and the metallic woodborers (Buprestidæ), which are the very ones whose larvæ are so extensively eaten by woodpeckers. Next to these were the click beetles (Elateridæ), that bore into various plants and do much damage, and a few weevils or snout beetles (Rhynchophora). A ground beetle (Carabidæ) was found in one stomach, and a ladybird (Coccinellidæ) in another, these being the only useful beetles taken.

Bees, wasps, and a few ants (Hymenoptera) amount to 27 percent. They are eaten regularly in every month when the bird is on its summer range. Five stomachs were taken in the vicinity of an apiary, but not one of them contained a trace of a honey bee, though one bird had eaten 24 percent of robber flies (Asilidæ), which have been known to prey upon bees.

Bugs (Hemiptera) aggregate about 20 percent of the food of the ash-throat, which is the largest showing for that order of insects yet found in the food of any flycatcher. They were all eaten in the months from May to August inclusive, and form a good percentage in each of those months. They belong to the families of stinkbugs (Pentatomidæ), shield bugs (Scutelleridæ), leafhoppers (Jassidæ), jumping plant lice (Psyllidæ), common plant lice (Aphididæ), tree hoppers (Membracidæ), cicadas (Cicadidæ), and assassin bugs (Reduviidæ). The last is a family of predaceous insects which are useful, as they destroy some harmful insects, but all the others are injurious, and some are pests. While many of these are taken upon the wing, probably some are picked from plants. One bird was seen on a mustard plant feeding upon the plant lice, which completely infested the

plant. One stomach was entirely filled with tree hoppers and two with cicadas.

Flies (Diptera) amount to about 14 percent and were eaten in nearly every month. Robber flies were identified in two stomachs, one of which has already been referred to. Most of the others were of the family of the common house fly (Muscidæ).

Caterpillars were found in 20 stomachs and moths in 7. Together they amount to 19 percent of the food. This shows that caterpillars are a favorite article of food with this bird, and proves that it does not take all its food on the wing. While no stomach was entirely filled with caterpillars, one contained nothing but moths.

Grasshoppers formed about 5 percent of the food, and were mostly taken in May, June, and July. One stomach contained nothing else. As they do not often come within reach of flycatchers, these insects must be especially sought for.

Various other insects and spiders amount to a little more than 3 percent. Among these the two most prominent were dragonflies and Raphidia. These last are small insects with remarkably long necks, and as they prey upon other insects and are said to feed upon the larvæ of the codling moth, their destruction by birds is to be deplored. Spiders are eaten by the ash-throat quite regularly, but not extensively. Apparently, most birds take spiders when found, but do not seek for them.

Vegetable food.—Vegetable food was found in 9 stomachs. Of these, 5 contained remains of elderberries; 2, bits of other small fruit; and 2, skins which might have been those of cultivated varieties. The total for the year is 8 percent.

Feeding of young.—Besides the examination of stomachs of the ash-throated flycatcher, observations were made upon the feeding of a nest of young situated in the cornice of an abandoned ranch house. The nest contained four young about a week old when first discovered. The number of feedings and times of observations are given in the following table:

Date.	Hours in forenoon.	Number of feedings.	Hours in afternoon.	Number of feedings.
June 18			12.59–1.59	9
June 22	10.48–11.48	14	2.07–3.07	9
June 26			2.13–3.13	18
Do			5.56–6.26 (half-hour.)	6
June 27	5.15– 6.15	28		
Do	11.27–12.27	9	4.47–5.47	9
June 28	5.26– 6.26	16		

In all, the nest was observed for eight and one-half hours and 119 feedings were noted, or an average of 14 feedings per hour. Both parent birds took part in the feeding until the female was unfortunately killed after the first hour of feeding on the morning of June 27. It will be noted that during this early hour more feedings were observed than at any other, and that at practically the same hour the next morning, June 28, the male bird alone was able to feed only 16 times. However, the young did well, and left the nest that afternoon. As the day was about fourteen hours long when the above notes were taken, each of the young birds must have been fed about 49 times every day, or 196 insects in all. It is safe to say that the parents would eat enough more to bring the total up to 250. Several nests of this bird in an orchard would make quite a difference in the number of insects surviving to propagate the next year's supply.

SUMMARY.

From the foregoing it is evident that the ash-throat attacks no product of husbandry, but keeps up an incessant war upon insects. Of these it devours a vast number in the course of the year, mostly harmful species. This bird likes to reside in the vicinity of houses, gardens, and orchards. Let it be encouraged by all means.

ARKANSAS KINGBIRD.

(*Tyrannus verticalis.*)

The Arkansas kingbird (Pl. II) inhabits the lower and warmer part of the State, mainly as a summer resident. It is not so domestic as its eastern relative, the common kingbird, and seems to prefer the hill country, with scattering oaks, rather than the orchard or the vicinity of towns or ranch buildings.

For the investigation of the kingbird's food 78 stomachs were available. Most of them were taken from March to July inclusive, but a few in September, October, and December. The bird's yearly food is made up of 87 percent of animal matter to 13 percent of vegetable.

Animal food.—The animal food is composed of insects and a few bones of a batrachian (tree frog or salamander). Both the eastern and western kingbirds have been accused of destroying honey bees (*Apis mellifera*) to a harmful extent. It is said that the birds linger about the hives and snap up the bees as they return home laden with honey. Remains of honey bees were searched for with special care, and were found to constitute 5 percent of the food. Thirty-one individuals were discovered in 5 stomachs. Of these, 29 were drones, or males, and 2 were workers. In 3 stomachs containing males there was no other food, and when it is borne in mind that there are thou-

A. Hoen & Co. Baltimore.

ARKANSAS KINGBIRD

sands of worker bees to one drone, it appears that the latter must be carefully selected. As a rule, the destruction of drones is not an injury to the colony, and often is a positive benefit. The food of the eastern kingbird shows practically the same ratio between drones and workers. Hymenoptera other than honey bees amount to 38 percent, and include wild bees, wasps, and ants, with a few parasitic species. The latter are very useful insects, and their destruction is an injury, but fortunately the kingbird is not especially fond of them.

The late Walter Bryant, of Santa Rosa, Calif., says:

> Mr. A. Barnett, of San Diego County, had 300 swarms of bees, which attracted the flycatchers to such an extent that he made some investigations to ascertain to what extent they might be damaging the bee industry.
>
> Over 100 flycatchers were dissected, principally Arkansas flycatchers and phoebes (Black and Say's?). In all of the Arkansas flycatchers drones were found, but no working bees, although in many cases the birds were gorged. In most of the phoebes drone bees were found; the only exception was that of a phoebe (Say's?) in which a bee's sting was found in the base of the tongue.
>
> The birds were all shot about apiaries and were seen darting upon and catching the bees.[a]

Such testimony is sufficient to clear these flycatchers of the suspicion that they interfere with the bee industry.

Beetles of various families form about 14 percent of the food. They are all harmful species except a few predaceous ground beetles and ladybird beetles. They were taken very regularly through the months, and appear to be a favorite food.

Orthoptera—grasshoppers and crickets—amount to 20 percent. They were taken pretty regularly through all the months. Even the 3 stomachs secured in December show an average of 44 percent. Probably few of these were caught on the wing, and their abundance in the food indicates that this bird, like many others, forsakes its usual style of feeding and goes to the ground to catch grasshoppers whenever they are numerous. Two stomachs were entirely filled with these insects, and in several others they amounted to over 90 percent of the contents.

Miscellaneous insects, consisting of caterpillars and moths, a few bugs, flies, and a dragonfly, constituted 10 percent. Several stomachs contained a number of moths, and one was entirely filled with them. Not many birds eat these insects extensively in the adult form, while the larvæ (caterpillars) are a prominent feature of the diet of most insectivorous birds. Besides insects, bones of some batrachian, probably a tree frog, were found in three stomachs and an eggshell in one. They amount to only a trifling percentage. Frogs or salamanders seem queer food for a flycatcher, but their bones have been

[a] Zoe, IV, pp. 57–58, 1893.

found in the stomachs of several species of tree-haunting insectivorous birds.

The following is a list of insects identified in the stomach of the Arkansas kingbird:

COLEOPTERA.

Platynus sp.
Aphodius fimetarius.
Amphicoma ursina.
Cremastochilus sp.
Geotrupes sp.
Megapenthes turbulentus.
Epicauta sp.
Hydaticus stagnalis.
Agabus sp.
Silpha ramosa.
Staphylinus luteipes.
Balaninus sp.

HYMENOPTERA.

Apis mellifera.
Prosopis affinis
Habropoda sp.
Melissodes sp.
Andrena sp.
Cryptus sp.
Ophion bilineata.

HEMIPTERA.

Euschistus servus.
Nezara sp.
Podisus modestus.
Calocoris rapidus.
Eurygaster alternatus.

Vegetable food.—The vegetable food of the Arkansas kingbird amounts to about 13 percent, and consists mostly of fruit. It was all contained in 15 stomachs, of which 10 held elderberries (*Sambucus*) and 5 various small berries not positively identified. One also contained an olive, the only cultivated fruit found. A few seeds also were noted.

SUMMARY.

In a summary of the economic significance of the food of this kingbird it should be noted that the bird must be judged by its destruction of insects, for, since it does not eat any product of cultivation to an appreciable extent, its vegetable food can be disregarded. The offense of eating honey bees, so long laid at this bird's door, is practically disproved, for the more or less useless drones eaten far outnumber the useful workers. The injury the kingbird does, if any, is by eating predaceous beetles and parasitic Hymenoptera, but it takes these in such small numbers as to leave no reasonable doubt that the bird is one of our most useful species.

CASSIN KINGBIRD.

One other species of *Tyrannus* (*T. vociferans*), commonly known as the Cassin kingbird, occurs in the southern half of the State, where it frequents orchards and ranches. It is less abundant than the Arkansas kingbird, but has similar habits, and an examination of several stomachs shows that the food of the two species is practically the same.

SAY PHOEBE.

(Sayornis saya.)

While the Say phoebe inhabits California throughout the year, it is locally wanting in summer in many places west of the Sierra. In the fruit-growing regions visited, the writer met with only one individual during the spring and summer months, but these phoebes became fairly numerous in September, and increased in numbers as the season advanced. The investigation of their food was based upon the examination of 86 stomachs, taken in every month from September to March inclusive, and 2 taken in June. This bird was shown to be one of the most exclusively insectivorous of the family, although no stomachs were available for the months when insects were most numerous. The food consists of 98 percent of animal matter and 2 percent of vegetable.

Animal food.—As a number of predaceous ground beetles (Carabidæ) were in these stomachs, a separate account was kept of them. They amount to somewhat over 5 percent, and are pretty evenly distributed through the months, except February, in which 25 percent were eaten. These were in one stomach, which they half filled, and as only 2 stomachs were taken in that month, the percentage was probably made too great. It seems impossible that all these beetles, which are rather averse to flying, could have been caught on the wing, especially since none were taken in the warmer months, when they are most active. In the other beetle food, which amounts to 10 percent, a few ladybirds (Coccinellidæ) were found. These and the ground beetles must be recorded against the bird, but the fault is not serious. The remainder of the beetles were all of injurious or neutral species.

Hymenoptera, including quite a number of ants, amount to 35 percent, and were contained in 69 stomachs, or over 78 percent of the whole. This illustrates the statement that these birds are wasp-catchers rather than flycatchers. A few parasitic species were among the rest. Bugs, as is so often the case, were eaten quite regularly, but in rather small quantities. They amount to about 5 percent of the food, and belong to the following families: Stinkbugs (Pentatomidæ), the squash-bug family (Coreidæ), leaf bugs (Capsidæ), negro bugs (Corimelænidæ), leafhoppers (Jassidæ), tree hoppers (Membracidæ), and assassin bugs (Reduviidæ). These last are reckoned as useful insects, but they were identified in only one stomach.

Flies (Diptera) aggregate 10 percent of the food, and were eaten mostly in the months of January, March, and November; but probably this is accidental and would not hold true with a greater number of stomachs. The only family identified was that of the common

house fly (Muscidæ). One stomach was entirely filled with them. Moths and caterpillars (Lepidoptera) appeared in 27 stomachs, and amount to something more than 10 percent of the food. Moths were found in 15 stomachs and caterpillars in 12. This is contrary to the usual rule that in this order of insects the larvæ are eaten by birds much more freely than are the adults.

Grasshoppers and crickets (Orthoptera) are eaten by the Say phoebe to the extent of 14 percent, which is the highest record of any flycatcher except the Arkansas kingbird. These, taken in connection with the ground beetles, ants, and caterpillars, indicate a somewhat terrestrial habit of feeding. Nearly 40 percent of the grasshoppers consumed were taken in September, after which they steadily decreased in quantity. One stomach was entirely filled with them.

Miscellaneous insects, spiders, and a few other creatures make up the rest of the animal food, about 8 percent. Of these, spiders were found in 10 stomachs, dragonflies in 5, sowbugs (*Oniscus*) in 1, and another unidentified crustacean in 1.

Vegetable food.—The vegetable food of the Say phoebe amounts to 2 percent, and is made up of a little fruit, a few seeds, and some rubbish. One seed and a stem of a fig were the only indications of cultivated fruit. Remains of elderberries were noted in 3 stomachs, seeds in 4, pulp of a large seed or nut in 1, and rubbish in 4.

SUMMARY.

The economic relations of the Say phoebe depend wholly upon its animal food, for it eats practically no vegetable matter of any interest to man. That it takes a few useful insects can not be denied, but the stomachs' contents show that they are far outnumbered by harmful species, and the balance is clearly in favor of the bird.

BLACK PHOEBE.

(*Sayornis nigricans.*)

The black phoebe inhabits the lower valleys of California, and in most parts can be found throughout the year. For a nest site it selects the wall of a canyon, a shed, the overhanging eaves of a barn, or, better still, a bridge. It has a pronounced preference for the vicinity of water. Even a watering trough by the roadside usually has its attendant phoebe.

While camping beside a stream in California, the writer observed the feeding habits of the black phoebe. The nesting season was over, and apparently the birds had nothing to do but capture food. This they appeared to be doing all the time. In the morning, at the first glimmer of daylight, a phoebe could always be seen flitting

from rock to rock, and probably it caught an insect on each flight. This activity was kept up all day. Even after supper, when it was so dark that notes had to be written by the aid of the camp fire, the phoebes were still hunting insects.

Observations like these convince any reasoning person that the number of insects destroyed in a year by this species is something enormous, and the examination of stomachs confirms field observations. This bird eats a higher percentage of insects than any flycatcher yet studied except the western wood pewee. For the study of this phoebe's food 333 stomachs were available, collected in every month in the year and from various parts of the State. They show 99.39 percent of animal matter to 0.61 percent of vegetable.

Animal food.—In examining the food contained in the stomachs of the black phoebes, account was kept of the beetles that are generally supposed to be useful, namely, the ground beetles (Carabidæ), the ladybirds (Coccinellidæ), and the tiger beetles (Cicindelidæ). It was found that these beetles were eaten pretty regularly throughout the year; in fact, there is no month which does not show a certain percentage of them. The average for the year, however, is only 2.82, or practically 3 percent, not a heavy tax on the useful beetles. Other beetles, all more or less harmful, amount to 10 percent. They were eaten in every month, and though the quantity varies to some extent, the variation appears to be accidental.

Hymenoptera amount to over 35 percent of the yearly food. They were found in 252 out of the 333 stomachs, and in 11 there was no other food. They are eaten throughout the year. March is the month of least consumption, with only 1 percent, while August shows the maximum, nearly 60 percent. A few ants and several parasitic species are eaten, but the great bulk of this item is made up of wild bees and wasps. Not a trace of a honey bee was found in any stomach.

Hemiptera of several families were eaten to the extent of about 7 percent. They were pretty uniformly distributed through the food of the year, except that none were taken in May, which, however, is probably accidental. Four of these families are aquatic, which partly explains why the bird is so fond of the vicinity of water. The Reduviidæ are insectivorous, and therefore useful. They were found in but one stomach. The other families are vegetable feeders; all of them likely to be harmful, and most of them pests. The plant lice found in the food are rather unexpected, but, as already noted, flycatchers do not take all their food on the wing.

Flies (Diptera) were eaten by the black phoebe to the extent of over 28 percent. They appear in every month, and range from 3 percent in August to 64 percent in April. They were found in 127 stomachs, 10 of which contained nothing else. The house-fly family (Muscidæ), the crane flies (Tipulidæ), robber flies (Asilidæ), and one

horsefly (Tabanidæ) were the only ones identified. Grasshoppers and crickets are not extensively eaten by the phoebe. They amount to about 2½ percent for the year, being eaten rather irregularly; five months show none at all. The greatest consumption was in April, nearly 8 percent.

Moths and caterpillars are eaten to the extent of 8 percent. They were found in 72 stomachs—moths in 38, caterpillars in 32, and both in 2. A few unidentified insects and several miscellaneous ones, principally dragonflies, with some spiders, make up the rest of the animal food, 6 percent. Dragonflies are taken quite frequently, but generally in no great numbers. One stomach was entirely filled with them, and several were nearly so. The fact is, these insects are so large that often a single one fills a phoebe's stomach. These insects are too strong and agile upon the wing to be captured by anything less expert than a flycatcher, and in the few instances where they appear in other birds' stomachs they were probably found dead. The spiders eaten by the phoebe are perhaps snapped from the tops of weeds as the bird flies over, or taken from the web. While quite frequently eaten, they form only a small percentage of the diet.

The following is a list of insects identified in the stomachs of the black phoebe:

COLEOPTERA.

Elaphrus riparius.
Trixna longula.
Bradycellus rupestris.
Laccobius ellipticus.
Philonthus pubes.
Hippodamia convergens.
Coccinella transversoguttata.
Coccinella californica.
Chilocorus orbus.
Cryptorhopalum apicale.
Hister bimaculatus.
Saprinus obscurus.
Saprinus lugens.
Saprinus lubricus.
Carpophilus hemipterus.
Heterocerus tristis.
Canthon sp.
Aphodius granarius.
Aphodius vittatus.
Aphodius ungulatus.
Amphicoma ursina.
Gastroidea sp.
Lina scripta.
Diabrotica soror.
Blapstinus pulverulentus.
Corphyra sp.
Notoxus alamedæ.

HEMIPTERA.

Hygrotrechus sp.
Largus succinctus.

In addition to the above species the following families of Hemiptera were identified:

Giant water bugs (Belostomatidæ).
Creeping water bugs (Naucoridæ).
Broad-shouldered water striders (Veliidæ).
Water striders (Hydrobatidæ).
Assassin bugs (Reduviidæ).
Leaf bugs (Capsidæ).
Red bugs (Pyrrhocoridæ).
Chinch-bug family (Lygæidæ).
Stink bugs (Pentatomidæ).
Leafhoppers (Jassidæ).
Tree hoppers (Membracidæ).
Jumping plant lice (Psyllidæ).
Plant lice (Aphididæ).

Vegetable food.—The vegetable food of the black phoebe amounts altogether to only 0.61 percent, and may be classified under two heads: Fruit and other vegetable matter. Fruit forms 0.34 percent, and the only species identified were elderberries in 19 stomachs, dogwood (*Cornus*) in one, and *Rubus* (blackberries or raspberries) in one. This last may have been cultivated; and some fruit skins found in 1 stomach may also have been of a domestic variety. Miscellaneous vegetable food consists of poison oak seeds in 2 stomachs, a catkin in 1, and rubbish in 1.

Food of young.—Among the 333 stomachs of the black phoebe were those of 24 nestlings, varying in age from 1 to 2 weeks. Their food was tabulated by itself to ascertain if it differed from that of the adults. No great difference was apparent in the kind of food eaten nor in the relative proportions. One point, however, was noted. The percentage of animal food was a little lower than in the adults; not because the young had intentionally eaten any vegetable food, but because, along with other food, the parents had fed a quantity of rubbish, dead grass, leaves, and the like. The same apparent carelessness as to the food of their young has been observed in other species.

SUMMARY.

In a summary of the food of the black phoebe the vegetable part may be dismissed as unimportant. Of the insect food we have less than 3 percent of theoretically useful beetles, a few parasitic Hymenoptera, and a few dragonflies, say, 5 percent in all, to offset 94 percent of harmful species. This phoebe is an efficient insect destroyer, and is an invaluable asset to the people of California or any other State it may inhabit. It should be rigidly protected and in every way encouraged.

WESTERN WOOD PEWEE.

(*Myiochanes richardsoni.*)

The western wood pewee is a familiar sight in the fruit-growing sections of the State, where its time is spent in a tireless search for insects. Wherever in the orchard there is a dead limb, there on the outermost twig perches the pewee, and from its lookout sallies forth to snatch up any luckless insect that comes within range. Several such perches are usually to be found not far apart, and the bird occupies them in turn as the game becomes scarce in one or the other place. The little western flycatcher (*Empidonax difficilis*) has the same habits, and shares these watchtowers with the pewee. Observation of one of these perches for three minutes, watch in hand, furnished a good idea of the bird's industry. In the first minute it took 7 insects, in the second 5, and in the third 6, or 18 in the three minutes.

Apparently it had been doing the same thing for an hour, perhaps all the morning. These observations were made at 10 a. m., when the air was warm and insects were on the wing. Either the same bird or another was watched the next day at 9 a. m. near the same spot, and 17 captures were noted in eight minutes. This morning was cooler, and fewer insects were abroad than on the previous day. The mean of these two observations is 4 insects per minute. If the bird keeps this up for even ten hours a day, the total is 2,400 insects. It hardly seems possible that one bird could eat so many unless they were very small, but this pewee is rarely seen when it is not actively hunting. When the young are in the nest, the parents must make great havoc with insects if the nestlings are fed at the above rate.

The pewee remains in California only about six months in the year, but fortunately this is the season when insects are most numerous. One hundred and thirty-seven stomachs, taken in the months from April to September inclusive, were available for examination. Animal matter formed 99.91 percent of the contents and vegetable matter 0.09 percent, or less than one-tenth of 1 percent. The percentage of animal matter is the highest yet found in the food of any flycatcher.

Animal food.—Beetles amount to about 5 percent of the food. With the exception of Carabidæ, found in 4 stomachs, and Coccinellidæ, in 5, all were either harmful or neutral species.

The following beetles were identified:

Coccinella 9-notata nevadica.
Coccinella californica.
Coccinella transversoguttata.
Hippodamia ambigua.
Hippodamia convergens.
Hister bimaculatus.
Saprinus plenus.
Carpophilus hemipterus.
Aphodius vittatus.
Agrilus sp. nov.
Agriotes sp.
Gastroidea sp.
Blapstinus sp.
Ptilinus basalis.
Baris rubripes.

Hymenoptera aggregate over 39 percent, and are of wild species—that is, there are no domestic bees among them. They were found in 93 stomachs, and in 14 there was nothing else. Parasitic species were identified in 7 stomachs and ants in only 2—an unusually small record for ants, which are favorite food with flycatchers.

Hemiptera, or bugs, are evidently not esteemed as an article of diet by this bird, for they amount to less than 2 percent of the food. None were eaten in April or May, but nearly half the whole number were taken in August.

Diptera amount to nearly 40 percent, slightly exceeding Hymenoptera. No other flycatcher has yet been noted whose food contained more Diptera than Hymenoptera; hence the name flycatcher is peculiarly applicable to this pewee. Diptera were found in 84 stomachs,

and 20 contained no other food. This would seem to indicate that flies are preferred to other insects. The families Muscidæ, Tipulidæ, and Asilidæ were recognized.

Caterpillars and moths amount to nearly 5 percent. Though not taken in great numbers, they are eaten regularly through the season. September shows the greatest consumption—over 14 percent. Moths were found in 18 stomachs and caterpillars in 4. One stomach was entirely filled with the remains of moths.

Sundry insects, amounting to nearly 9 percent, make up the rest of the animal food. Dragonflies were found in 7 stomachs, and 1 contained nothing else. Ephemerids were in 4 stomachs, lace-winged flies in 1, spiders in 3, and the so-called jointed spiders in 1.

The character of the food shows that it is taken on the wing more exclusively than that of any other bird yet examined. Of the creatures that do not fly, ants were found in 2 stomachs, caterpillars in 4, spiders in 3, and jointed spiders in 1. As some ants fly, these may have been taken in mid-air, but they were too badly broken to determine this point.

Vegetable food.—Vegetable matter was found in 4 stomachs, but in 3 of these it was mere rubbish. One contained seeds of the elderberry, the only vegetable food observed.

SUMMARY.

The western wood pewee, while often an inhabitant of the orchard, does not deign to taste of its product, if the above record may be assumed to be conclusive. Its diet is composed almost exclusively of insects, and of these a large majority are harmful species.

WESTERN FLYCATCHER.

(*Empidonax difficilis.*)

The western flycatcher avoids alike the hot valleys and the high mountains of California during the warmer months, but is more generally distributed in migration. For a nesting site it selects a tree, a crevice among the roots of an overturned stump, a bracket under a porch, a beam under a bridge, or a hole under an overhanging sod on the bank of a stream. It has much the same liking for water as the black phoebe, though even more pronounced. A small stream running through or near an orchard appears to supply ideal conditions for this little flycatcher, as the orchard makes an excellent foraging ground, and if it does not afford a nesting site, the bank of the stream will. The bird is quiet and unobtrusive, and often the first notice one has of its presence is to see it dart from the end of a near-by twig into the air in pursuit of an insect. It seems to be thus engaged all day; in fact, the writer has never seen one of these birds when it was not in search of food.

In the laboratory investigation of the food of the western flycatcher 141 stomachs were examined. They were collected from March to October inclusive, and probably give a fair idea of the bird's food for these months. Analysis gives 99.28 percent of animal food to 0.72 percent of vegetable; in other words, there was less than three-fourths of 1 percent of vegetable matter. Only one other flycatcher, the western wood pewee, eats so little vegetable food.

Animal food.—In this analysis a separate account was kept of the ladybird beetles (Coccinellidæ). This bird appears to eat more of them than does any other flycatcher, but the number for the whole season is not large enough to be very serious. The greatest consumption occurred in August, a little more than 7 percent. The average for the season is 2⅓ percent. Other beetles amount to nearly 6 percent, nearly all harmful, the exception being a few ground beetles (Carabidæ).

Hymenoptera form the largest constituent of the food of this as of most other flycatchers. They amount to over 38 percent, and are an important item during every month of the bird's stay on its summer range. The highest percentage is in March, 61; but as only 3 stomachs were taken in that month, the record can not be considered as final. June shows 52 percent, and is probably nearer the true maximum, although August and September do not fall much below. Ants were found in 14 stomachs, and parasitic Hymenoptera in but 2. Hymenoptera in general were found in 99 stomachs, and 6 contained nothing else. No honeybees were identified.

Hemiptera (bugs) amount to nearly 9 percent of the food. They were found in 49 stomachs, 2 of which were entirely filled with them. The greatest number were taken in August, when they constituted 29 percent. The following families were identified:

Stink-bug family (Pentatomidæ).
Chinch-bug family (Lygæidæ).
Leaf-bug family (Capsidæ).
Leafhopper family (Jassidæ).
Tree-hopper family (Membracidæ).

Diptera amount to a little more than 31 percent of the whole food. They rank next to Hymenoptera, and, like those insects, are taken very regularly during every month of the bird's stay in the State. While October is the month of maximum consumption, 47 percent, several other months are but little below. Only 3 families were identified: The crane flies (Tipulidæ), the soldier flies (Stratiomyiidæ), and the house flies (Muscidæ).

Lepidoptera, in the shape of moths and caterpillars, amount to about 7 percent for the year, and were found in every month except March. They appeared in 36 stomachs, of which only 7 contained the adult insects—moths—and 29 the larvæ or caterpillars. This taste is in contrast with that of the black phoebe and the wood pewee,

which prefer moths, but is quite in accordance with the general rule among insectivorous birds. Special interest attaches to this item of the bird's food from the fact that larvæ of the codling moth were found in 3 stomachs. In one 15 were counted, which amounted to 89 percent of the food. In another they were too badly broken to be counted, but formed 55 percent of the contents. In the third only 1 was found, amounting to 3 percent. Evidently these insects were hibernating in a crevice in the bark of a tree or some similar place, and were there discovered by the flycatcher.

A few unidentified insects and some spiders make up the remainder of the animal food—about 6 percent. Spiders were found in 19 cases—in 1 stomach amounting to 70 percent—and these, with the caterpillars, particularly the codling-moth larvæ, show that a considerable percentage of the food of this bird is not caught on the wing.

The following is a list of insects identified from the stomachs of the western flycatcher:

COLEOPTERA.

Aleochara bimaculata.
Hippodamia ambigua.
Hippodamia convergens.
Coccinella californica.
Scymnus sp.
Telephorus divisus.
Aphodius sp.
Limonius infuscatus.
Gastroidea cyanea.
Diabrotica soror.
Monoxia sordida.
Epitrix sp.
Eulabis rufipes.
Blapstinus ruficeps.
Deporaus glastinus.
Balaninus sp.

DIPTERA.

Stratiomyia maculosa.

LEPIDOPTERA.

Carpocapsa pomonella.

Vegetable food.—Vegetable matter was found in 16 stomachs, though some of it could not properly be called food. One stomach contained seeds of Rubus fruit (blackberries or raspberries); 7, seeds of elderberries; 1, the skin of an unidentified fruit and a seed of tarweed (*Madia*); while 6 held rubbish. The Rubus fruit might have been cultivated, but probably was not.

Food of young.—Among the stomachs whose contents have been discussed were those of 15 nestlings, varying in age from 48 hours to 2 weeks, which show no marked differences from those of adults. Only 2 of these stomachs contained any vegetable matter; in 1 was 15 percent of rubbish; in the other 3 percent. Gravelstones were found in several cases, and have been observed in the young of other insectivorous birds, even when not found in adults of the same species.

The young in one nest were fed 24 times in an hour. Owing to the nest's location the number of nestlings was not ascertained. If there were four, as is probable, and the feeding was continued fourteen hours, each was fed 84 times during the day.

SUMMARY.

From the foregoing it is evident that neither the farmer nor the fruit grower has anything to fear from the western flycatcher. Practically it eats no vegetable food, and its animal diet contains less than the normal proportion of useful elements. It should be rigidly protected at all seasons.

OTHER FLYCATCHERS.

Four or more other species of the genus *Empidonax* occur within the limits of California. They are not so domestic as the one just discussed, but their food habits are quite similar. One, *E. trailli*, is locally quite abundant, but chooses the willows along water courses for its home rather than the orchards. The others are less widely distributed and therefore of less economic importance. A few stomachs of each species have been examined, but they indicate no remarkable differences in food habits from those of the western flycatcher.

HORNED LARK.

(*Otocoris alpestris chrysolæma*, *rubida*, and other subspecies.)

Not only in California, but in a considerable portion of temperate North America, some form of the horned lark occurs wherever plain or valley presents the condition suited to its peculiar needs. The former generic name, *Eremophila*, or desert lover, was peculiarly appropriate, but unfortunately it was necessary to displace it. Bare, level ground with scant herbage and no trees or shrubs appears to be the ideal condition for the horned lark. While on the Pacific coast they are not called upon to endure excessive cold, yet elsewhere they endure low temperatures not only with indifference but with apparent pleasure. The writer has met them on an open prairie when the temperature was nearly 30 degrees below zero, and though a fierce gale was blowing from the northwest they did not exhibit the least sign of discomfort, but rose and flew against the wind, then circled around and alighted on the highest and most windswept place they could find. Probably they remain through the night in these bleak spots, for they may frequently be seen there after sunset. Most animals seek shelter from wind and cold, even though it be nothing but the leeward side of a ridge or hummock, but the horned lark refuses to do even this, and by preference alights on the top of the knoll where

the wind cuts the worst. It seems strange that in so small a body the vital heat can be maintained under such adverse conditions, but if one of these birds be examined, its body will be found completely covered with a thick layer of fat, like the blubber on certain marine animals. This indicates that horned larks have plenty to eat, and that their food is largely carbonaceous. The necessity for such heat-producing food does not exist in the case of the California horned larks, but nevertheless they eat the same substances as those in a colder climate, although probably in reduced quantities.

The food of this bird consists largely of seeds picked up from the ground. Very naturally a bird that subsists on scattered seeds would pick up kernels of grain if they came in its way, and some persons have declared that this bird does serious damage to newly sown grain. As they sometimes associate in immense flocks, they may do harm when large numbers alight on a field before the grain has been harrowed in. Drilling the grain, which is the modern method, will obviate this trouble. Most of the grain eaten by these larks is waste from the harvest field.

For the investigation of the food of the horned larks of California, 259 stomachs, collected in every month except May, were available. While very irregularly distributed through the year, they probably give a fair idea of the annual food. In the analysis of the contents of these stomachs, approximately 9 percent of animal food was found to 91 percent of vegetable.

Animal food.—The horned lark is essentially a vegetarian, but eats a considerable number of insects during the reproductive season and feeds many to the young. Most of the animal food was taken between March and June, inclusive. The latter has the highest record, nearly 30 percent. As this lark is an early breeder, it begins eating insects early in the season. After June there is a rapid decrease in animal food, and the stomachs taken in November contained none whatever.

For convenience this part of the diet may be divided into the two items, beetles and other insects. Beetles amount to about 5 percent. Like the animal food in general, they were found in greatest quantities in the stomachs taken from March to June, the latter month showing a little over 20 percent. While a few predaceous ground beetles were eaten, the great bulk of these insects were of harmful species, among which were some snout beetles or weevils. The remainder of the animal food, 4 percent, consisted of bugs, ants, caterpillars, and a few miscellaneous insects and spiders. Of these, the greater number are either harmful or neutral.

Vegetable food.—The great interest in the food of the horned lark centers about the vegetable part. This consists of grain and weed seed. Corn was found in only one stomach. Wheat was contained

in 21 stomachs, taken in four months: January, February, June, and July. The irregularity in eating grain would seem to indicate that it is not a favorite food. The midsummer records may be explained on the ground that these are the harvest months in California. But it is not supposable that wheat could be obtained in January and February and not in December or March. The greatest amount was eaten in February, 74 percent, but only 5 stomachs were taken in this month, and probably a greater number would have given a lower percentage. The average for the year is 9 percent. Of all the grains, however, oats are the favorite with the horned larks, as they are with so many other seed-eating birds. They were eaten much more regularly than wheat and in greater quantities. They were found in 142 stomachs, and November gives the highest record, 77 percent, while June has the lowest, a little over 8 percent. The average for the year is 31 percent. If all these oats were taken from the farmer's crop it might be a serious tax, but evidently only a few of them are so obtained. Those eaten in March may have been from newly sown fields, and those in June and July from the ripening crop, but the rest must have been waste grain gleaned from the fields, Moreover, California is covered with wild and volunteer oats, which, ripening at other times than the cultivated ones, furnish an inexhaustible supply of food for many birds. It is certain that most of the oats eaten by the California horned larks are either waste or volunteer grain, and have no economic value.

The particular food of horned larks is the seeds of weeds and grasses. These aggregate 51 percent of the annual diet, being eaten in every month, and constitute a respectable percentage of the food in each. The month of least consumption is January, when they amount to over 19 percent; August shows the maximum quantity, nearly 99 percent, but as only 4 stomachs were taken in this month, probably ample material would reduce this high percentage. It is by the consumption of weed seed that the horned lark makes amends for doing a little damage to grain. The quantity of seeds of noxious weeds destroyed annually by this species throughout the country is very great. Fruit does not appear in the stomachs of horned larks. The bird asks nothing of the orchardist—not even the shelter of his trees.

SUMMARY.

In the final analysis of the food habits of the horned lark there is but one tenable ground of complaint, namely, that it does some damage to newly sown grain. This can be largely remedied by harrowing in immediately after sowing, and can be wholly prevented by drilling. The bird's insect diet is practically all in its favor, and in eating weed seed it confers a decided benefit on the farmer. It should be ranked

as one of our useful species, and protected by law and by public opinion.[a]

JAY FAMILY.

The jays have acquired a questionable reputation owing to the fact that they pilfer the nests of other birds and prey upon the farmer's crops. That at times they are guilty of both of these sins can not be denied. On the first of these counts the California jay is far more culpable than its eastern relative and does entirely too much nest robbing for the best interests of the State. It is also a despoiler of fruit in its season, and in this respect should be restrained. On the other hand, jays are conspicuous and ornamental elements in the bird fauna, and inasmuch as they consume many harmful insects, should not be wholly condemned.

Some half dozen species and subspecies of jays occur in California. The food of the two most important species is discussed in the following pages.

STELLER JAY.

(*Cyanocitta stelleri frontalis* and *carbonacea*.)

The Steller jay inhabits the mountains and forested areas of California throughout the year. It sometimes ventures to the edges of the valleys and occasionally visits orchards for a taste of fruit, of which it is very fond, but in general it keeps to the hills and wilder parts of the canyons. It is fond of coniferous trees and is likely to be found wherever these abound. Where ranches have been established far up the canyons among the hills, this jay visits the ranch buildings. While it has all the characteristics of the jay family, it is rather more shy than either the California jay or the eastern bluejay.

To determine the nature of the food of this species, 93 stomachs were available. They were distributed over the whole year except February and April. The contents consisted of animal food to the extent of 28 percent, and vegetable matter 72 percent.

Animal food.—Beetles amount to a little more than 8 percent: Carabidæ were found in 8 stomachs; all the others were of noxious species. One stomach was half filled with a species of weevil or snout beetle (*Thricolepis inornata*), of which 35 individuals were counted, and there were probably more. Hymenoptera amount to about 11 percent and are the largest item of animal food. They were found in 30 stomachs altogether, and 2 were entirely filled with them. Ants were found in only 2 stomachs. Three honey bees were identified, one in each of 3 stomachs. One was a worker, another a drone, and the

[a] For a more complete account of the food habits of the horned lark, see Bulletin No. 23, Biological Survey, U. S. Department of Agriculture, The Horned Larks and their Relation to Agriculture, by W. L. McAtee, 1905.

third indeterminate. None of the smaller parasitic Hymenoptera were identified. The greater part of this item of food consisted of wasps and wild bees, which would indicate that this bird is an energetic and expert insect catcher.

Hemiptera (bugs) are evidently not in favor with the Steller jay. They were found in but few stomachs and in small numbers and amount for the year to little more than 1 percent. Pentatomidæ, or stinkbugs, and Scutelleridæ, or shield bugs, were the only families identified. Diptera form only four-tenths of 1 percent. They were found in only 3 stomachs, taken at the same place and at the same hour. They consisted of crane flies (Tipulidæ) filled with eggs.

Orthoptera (grasshoppers and crickets) aggregate about 3.5 percent. They appeared in 28 stomachs and were the sole contents in one. Caterpillars and moths amount to a little more than 2 percent. The former were found in 17 stomachs and the latter in 2.

The following insects from the stomachs of the Steller jay were identified:

COLEOPTERA.

Sinodendron rugosum.
Dichelonycha fulgida.
Clerus sphegus.
Thricolepis inornata.

HYMENOPTERA.

Apis mellifera.

Of miscellaneous creatures, spiders were identified in 3 stomachs, raphidians in one, and sow bugs (*Oniscus*) in one; altogether they make up about one-half of 1 percent. Remains of vertebrates amount to a little more than 1 percent. They consist of hair and skin of a mammal found in one stomach, two bits of bone, probably of a frog, in one, and eggshells in 13. This last item is the worst in this jay's record, since it indicates that the bird is guilty of eating the eggs of smaller birds; but even this is not as bad as it looks. Only 6 of these egg-eating records occurred in June, the nesting month. All the rest were in September or later and were probably old shells picked up in abandoned nests or about ranch buildings or camp grounds.

Vegetable food.—The vegetable food may be divided into fruit, grain, mast, and miscellaneous matter. Fruit amounts to 22 percent and was found in 55 stomachs. Prunes were identified in 2 stomachs, cherries in 2, grapes in 2, Rubus fruits in 15, strawberries in 1, elderberries in 15, bay laurel fruit in 1, unknown wild fruit in 2, and fruit pulp, not fully identified but thought to be of cultivated varieties, in 16 stomachs. Thus 38 stomachs held fruit supposed to be cultivated. This number includes all containing Rubus fruits, which probably were not all cultivated—perhaps none of them were. The Steller jay undoubtedly eats considerable fruit, but most of its range lies in unsettled areas, and it is too shy to visit orchards, except those close to the

timber. For the present, then, or until it becomes more domestic, the damage to cultivated fruit is likely to be small.

Grain amounts to 5 percent, and was found in 15 stomachs, distributed as follows: Wheat in 7, oats in 9, and barley in 1. Much of the wheat was damaged, and, in fact, owing to the times of year, it could not have been otherwise. The greatest amount of grain was taken in June, 24 percent, and was probably picked up in the harvest field. Many of the oats, perhaps all, were of the wild variety. The chief food of this jay, however, is acorns, though occasionally it eats other nuts or large seeds. Mast amounts to 42.5 percent of the yearly diet, and was found in 38 stomachs. In some of them it reached 99 percent of the contents. In October and November it amounted to 76 percent, in December to 90, and in January to 99 percent. Even in June, when other food was abundant, it was eaten to the extent of nearly 10 percent, though none was found in the stomachs taken in May or July. Very likely a considerable part of this was stolen from the stores of the California woodpecker, for it is hardly probable that the jays find acorns under the trees so late as June and so early as August. It is true the jays themselves store up nuts to some extent, but hardly on the scale indicated by the contents of their stomachs when the acorn harvest is long past. Seeds, galls, and miscellaneous matter make up the remainder of the vegetable food, about 2.5 percent. In two stomachs taken near the ocean were tangles of confervæ and other seaweeds.

SUMMARY.

From the foregoing analysis it will be seen that the food of the Steller jay is of minor importance from an economic point of view. In destroying beetles and Hymenoptera it performs some service, but it destroys only a few. Of the order of Hemiptera, which contains most of the worst pests of the orchardist and farmer, it eats scarcely any. The Orthoptera, which are almost all harmful insects, are eaten only sparingly, and the same applies to the rest of the insect food. The destruction of birds' eggs is the worst count against the jay. But none were found, except in June, until September, when it was too late in the season for fresh eggs to be obtainable. In June 17 birds were taken, and 6 of them, or 35 percent of the whole, apparently had robbed birds' nests. Now, it is evident that if 35 percent of all the Steller jays in California each rob one bird's nest every day during the month of June the aggregate loss is very great.

So far as its vegetable food is concerned, this bird does little damage. It is too shy to visit the more cultivated districts, and probably will never take enough fruit or grain to become of economic importance. The other vegetable food it consumes is entirely neutral from the economic standpoint.

CALIFORNIA JAY.

(*Aphelocoma californica.*)

The California jay (Pl. III) occupies the warm chaparral-covered lower slopes of the Sierra Nevada and Coast ranges and adjacent valleys. He has the same general traits of character as the eastern jay, is the same noisy, rollicking fellow as that bird, and in California occupies a corresponding position in bird society. While for the most part a frequenter of woods and chaparral, he is by no means shy of visiting orchards and gardens, and will come even to the farm buildings if anything there interests him. A nest of the chipping sparrow (*Spizella passerina arizonæ*), which was being watched for notes on feeding, was robbed of its four nestlings early one morning by a jay, although not more than 30 feet from the front door of a house on the edge of the village. He is a persistent spy upon domestic fowls and well knows the meaning of the cackle of a hen. A woman whose home was at the mouth of a small ravine told the writer that one of her hens had a nest under a bush a short distance up the ravine from the cottage. A jay had found this out, and every day when the hen went on her nest the jay would perch on a near-by tree. As soon as the cackle of the hen was heard, both woman and bird rushed to get the egg, but many times the jay reached the nest first and secured the prize. A man living in the thickly settled outskirts of a town said that jays came every morning and perched on some large trees that overhung his barnyards, where the hens had their nests, and that it was necessary for some member of the family to be on the lookout and start at the first sound of the hen's voice or a jay would get the egg.

A still worse trait of the jay was described by a young man engaged in raising poultry on a ranch far up a canyon near wooded hills. When his white leghorn chicks were small, the jays would attack and kill them by a few blows of the beak, and then peck open the skull and eat the brains. In spite of all endeavors to protect the chicks and to shoot the jays, his losses were serious.

As a fruit-eater the jay has few equals. He has a pronounced taste for cherries and prunes, and where orchards of these fruits are near natural coverts, he will work unceasingly to carry off the fruit. The writer remained in a cherry orchard in such a situation from 9 a. m. to 4 p. m. on several occasions during the cherry season, and there was not an hour of that time that jays were not going away with fruit and coming for more, in spite of the fact that every one was shot that was unwary enough to give the collector a chance. A small prune orchard on some bottomland, just where a small ravine debouched from the wooded hills, was also watched. The fruit was just ripening, and a continuous line of jays was seen pass-

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CALIFORNIA JAY

ing from the hills down through the ravine to the orchard, while a return line, each jay bearing a prune, was flying up the ravine to the woods, where, probably, the fruit was secreted and left to rot. The jay habitually stores nuts and grain for future use, and no doubt, urged by a misdirected instinct, lays up fruit for the same purpose, but with a different result. Several hours later the jays were still at work. On another occasion 7 jays were shot successively from a prune tree loaded with fruit, and others continued to come, unterrified by the report of the gun or the dead bodies of their comrades that lay on the ground beneath the tree.

The jay is also a notorious pilferer of nuts, notably almonds and English walnuts. He is a skillful nutcracker, and extracts the kernel deftly by holding the nut between his feet on a branch, while he hammers it with his beak until he cracks the shell. Only the hardest nuts defy his powers. A gentleman who owned a large ranch situated in a canyon and on the surrounding hills planted a dozen or more almond trees to raise nuts for home use. When the trees came to bearing, the jays each year carried all the nuts away before they were ripe. "Although," said the owner, "the trees bear a fair crop, I never get a nut; the jays take them all." Another gentleman had a number of very large English walnut trees on his ranch, which was at the upper end of a wooded canyon. While these nuts were yet unripe, the jays destroyed a great many. Fortunately, when mature, they seem to be too hard for the jays to peck through, so the bulk of the crop was saved.

But the jays do not frequent orchards entirely for fruit. During May and June the writer many times visited an apple orchard, the leaves of which were badly infested with a small green caterpillar, locally known as the canker worm. When a branch is jarred, these insects let themselves down to the ground on a thread spun for the purpose. Many jays were seen to fly into the orchard, alight in a tree, and then almost immediately drop to the ground. Observation showed that the caterpillars, disturbed by the shock of the bird's alighting on a branch, dropped, and that the birds immediately followed and gathered them in. These caterpillars were found in the stomachs of several jays, in one case to the extent of 90 percent of the contents.

For the laboratory investigation of the food of the California jay, 326 stomachs were used. They were distributed through every month, but the greater number were taken from May to September, inclusive. As many of them as possible were collected about orchards, gardens, ranch buildings, and stock yards. In the first analysis the food divides into 27 percent of animal matter and 73 percent of vegetable. The greatest percentage of animal food occurs in April, when it reaches 70 percent. After that it decreases gradually to

January, when it falls to its minimum of a little less than 5 percent. Vegetable food, on the contrary, is most sparingly eaten in April and most abundantly in January.

Animal food.—As the jay is largely a ground feeder, careful account was kept of the predaceous ground beetles (Carabidæ). In May they amount to 10 percent of the food and to nearly as much in February; but in the other months they are insignificant. The total for the year is 2.5 percent. Other beetles, all either harmful or neutral, amount to a little more than 8 percent. They are eaten rather irregularly through the year. April shows the greatest consumption, nearly 31 percent, and January the least, only a trace.

Hymenoptera, in the shape of wasps, bees, and ants, amount to a little less than 5 percent. They were contained in 189 stomachs and were distributed as follows: Honey bees in 9, ants in 27, other Hymenoptera in 159. These figures illustrate the fact that a bird will eat a certain article of food very often, but in small quantities. While Hymenoptera amount to less than 5 percent of the food, they were found in nearly 58 percent of the stomachs. The honey bees, 20 in number, were found in 9 stomachs, and, what is very singular, all were workers. Birds that eat honey bees usually select the drones, but the jay appears to have chosen the workers. Fortunately he does not appear to eat many.

Hemiptera were eaten to the extent of less than one-half of 1 percent. One stomach contained 2 black olive scales (*Saissetia oleæ*). Diptera seem even less acceptable than bugs as an article of food. In July, the month of greatest consumption, there were less than 1 percent.

Lepidoptera (moths and caterpillars) amount to 2.5 percent. They were eaten in every month, mainly in the caterpillar stage. May was the month when the greatest number was eaten, nearly 10 percent. The most interesting point, however, in connection with this item of food is that 12 pupæ of the codling moth were found distributed through 8 stomachs. This is a most unexpected service from a bird of the jay's habits, and it may be said that a little work of this kind will cover a multitude of sins in other directions.

Orthoptera (grasshoppers and crickets) are eaten to the extent of 4.5 percent. Most of them were taken in July, August, and September. As usual, August stands first, with a consumption of nearly 17 percent, and one stomach contained the remains of 41 individuals. *Melanoplus devastator* was the only species identified. As the jay is, to a great extent, an inhabitant of the woods, it was natural that its stomach should contain quite a number of the brown wood cricket. A mole cricket also was found in one stomach. Orthoptera were found in 151 stomachs and formed the total food in one. When they

are eaten so often, it is surprising that they do not form a larger percentage of the food.

A few miscellaneous creatures, such as raphidians, spiders, snails, etc., form less than one-half of 1 percent of the food.

The following is a list of insects identified in the stomachs of the California jay:

COLEOPTERA.

Amara conflata.
Silpha ramosa.
Limonius fulvipes.
Perothops witticki.
Onthophagus sp.
Diabrotica sp.
Coniontis robusta.
Blapstinus rufipes.
Sciopithes obscurus.
Balaninus sp.

HEMIPTERA.

Sinea diadema.
Saissetia oleæ.

HYMENOPTERA.

Apis mellifera.

LEPIDOPTERA.

Carpocapsa pomonella.

ORTHOPTERA.

Melanoplus devastator.

Besides the insects and other invertebrates already discussed, the jay eats some vertebrates. The remains consisted of bones or feathers of birds in 8 stomachs, eggshells in 38, bones of small mammals (mice and shrews) in 11, and bones of reptiles and batrachians in 13 stomachs. In destroying small mammals the jay is conferring an unmixed good, as practically all of them are injurious. His appetite for reptiles and batrachians, however, is unfortunate. These creatures, being mostly insectivorous, are very useful. Probably, however, their ranks are not seriously thinned by the jay. Of those eaten, 9 were lizards, one a snake, one a frog, and 2 others were batrachians, but could not be further identified. The great interest in the jay's vertebrate food, however, centers about the remains of birds and eggs. Of the 46 stomachs containing these remains, 17 were taken between the middle of May and the middle of July, and, as this period practically covers the nesting season in California, all may be considered as from the nests of wild birds robbed by the jay. The others represent either the eggs of domestic fowls or old eggshells. In the above period 95 stomachs were collected, of which 17, or 18 percent, contained eggs or remains of young birds. If we may infer, as seems reasonable, that 18 percent of the California jays rob birds' nests every day during the nesting season, then we must admit that the jays are a tremendous factor in preventing the increase of our common birds. Mr. Joseph Grinell, of Pasadena, after careful observation, estimates the number of this species in California at about

126,000. This is probably a low estimate. If 18 percent of this number, or 22,680 jays, each robs a nest of eggs or young daily for a period of sixty days from the middle of May to the middle of July, the total number of nests destroyed in California by this one species every year is 1,360,800. These figures are somewhat startling, representing as they do an enormous number of useful birds, and it is to be hoped they exaggerate the damage. For the present, however, they must stand for what they are worth. More data are necessary in order to determine fully the accuracy of the figures. Little weight attaches to the destruction of the eggs of domestic fowls by this jay, since in most cases it is easily preventable.

Vegetable food.—Aside from a few miscellaneous items, that altogether amount to less than 1 percent, the jay's vegetable food may be classed under three heads: Grain, fruit, and mast. Owing to the economic importance of this food the full tabulation is given below:

Month.	Grain.	Fruit.	Mast (acorns).	Month.	Grain.	Fruit.	Mast (acorns).
January	9.40	9.00	74.90	August	18.73	48.53	0.21
February	6.43	.....	69.14	September	24.26	19.89	31.65
March	45.50	.....	27.00	October	.29	.....	88.57
April	5.00	.....	24.75	November	.....	11.14	66.29
May	2.43	61.41	.68	December	.....	17.50	73.00
June	10.27	51.29	2.22				
July	18.42	44.94	.19	Average.	11.73	22.05	38.22

It will be seen that March holds the highest record for grain. This was probably picked up from fields newly sown. After that, not much is eaten until June, when the harvest begins. From that time on, grain is an important article of diet, and is obtained by gleaning in the harvested fields. It makes a sudden drop at the end of September, for at that time the acorn crop comes in. Grain was found in 95 stomachs, of which 56 contained oats; 34, corn; 2, wheat; 2, barley; and 1, grain not further identified. Many of the oats were of the wild variety.

Fruit was found in 270 stomachs. Of these, cherries were identified in 37, prunes in 25, apples in 5, grapes in 2, pears in 2, peaches in 1, gooseberries in 2, figs in 1, blackberries or raspberries in 71, elderberries in 42, manzanita in 4, cascara in 1, mistletoe in 1, and fruit pulp not further identified in 76. It will be noted that most of the fruit was eaten in the five months from May to September, inclusive. All found in November, December, and January was fruit pulp without seeds, evidently old fruit left on the trees. All the small fruits, as raspberries and elderberries, were taken during the summer months. The raspberries may have been either wild or cultivated, and were probably both; but in any case it is safe to say that half of the fruit eaten was of wild varieties and of no economic value.

Mast forms the largest item of the jay's food. This fact has some economic interest, since mast possesses considerable value as food for stock, especially hogs. A glance at the table will show the high percentages for the eight months from September to April inclusive, and then the sudden drop to the low rank it holds for the rest of the year. While the average consumption for the year is 38 percent, for these eight months alone it rises to nearly 57 percent, or more than half of the whole food. Doctor Merriam says that by the Indians this jay is called the oak planter. There is no doubt that all jays unconsciously aid in planting forest trees. Like the California woodpecker they habitually store up nuts and other large seeds, though unlike that bird they do not prepare storage places, but place them in forks of trees, cracks in old stumps or logs, behind loose pieces of bark, or bury them in the ground. Nuts are often dropped when being carried to a place of concealment, and sprout and grow to renew the forest.

SUMMARY.

The insect food, though small in amount, may be set down to the jay's credit. By the destruction of birds' eggs and young, it does serious mischief. Two items of its vegetable food, grain and fruit, are against the jay. In the case of grain, however, it is doubtful if much damage is done, since it is taken mostly after the harvest. If the grain taken in early spring is stolen from newly sown fields, it represents a real loss; but the jay is not known to pull up grain after it has sprouted, so that all it gets at this time must have been left uncovered, and is therefore of minor importance. After harvest it is common to see small companies of jays in fields, where they probably glean scattered kernels as well as some insects. In the matter of fruit stealing there are no extenuating circumstances. Wherever orchards are near its haunts, the jay is a persistent and insatiable fruit thief. If he took only what is necessary to satisfy the appetites of himself and family, he might be endured for the sake of his better traits. But long after his hunger is appeased, he continues to carry off fruit to store away, and thus his pilferings are limited only by his numbers and by the size of the fruit crop. Moreover, much of the fruit which he pecks is left on the tree to rot, and more falls to the ground unfit for use, except by pigs. It is fortunate that only orchards situated near the jay's usual haunts suffer severely. Those farther away are visited occasionally, but are not seriously damaged. Unlike many other birds which prey upon the earlier fruits, the jay continues his depredations as long as fruit is to be had. In an orchard closely watched by the writer it was found that when the earlier cherries were ripening, blackbirds, thrushes, orioles, grosbeaks, cedar birds, and linnets, as well as jays,

were present in numbers, but two weeks later, when the earlier varieties were gone and the later ones were ripe, hardly any smaller birds were present, while the jays were as busy as ever; and still later, at the end of the season, when the prune crop came on, jays were still taking a heavy toll.

It will thus be seen that the jay has many more bad qualities than good. In fact, from the economic point of view he has few redeeming virtues. Something may be said in his favor from the esthetic side, as he is a handsome bird, and people interested in country life would no doubt miss his familiar presence. But as the case stands there are far too many California jays. If they could be reduced to a fourth or a half of their present numbers, the remainder would probably do no serious harm. This is exactly what is likely to take place gradually as the State becomes more thickly settled and forest and chaparral lands decrease.

BLACKBIRD, ORIOLE, AND MEADOWLARK FAMILY.

(*Icteridæ.*)

The family which includes the orioles, blackbirds, and meadowlarks embraces species widely different in form, plumage, nesting habits, and food. The orioles nest in trees and obtain the greater part of their food thereon. The blackbirds nest upon low trees, bushes, or reeds, and take their food from trees to some extent, but mostly from the ground. The meadowlarks, the most terrestrial of all, nest upon the ground and obtain nearly all of their food there. Orioles eat the greatest percentage of insects, the meadowlarks eat a little less, while the blackbirds eat the least. Blackbirds rank next to sparrows as eaters of weed seeds, especially in winter.

Besides the Brewer blackbird there are in California 5 species and subspecies of redwinged blackbirds, which are so much alike that most of them can be distinguished only by ornithologists. All have practically the same nesting habits, and their food is not essentially different.

BICOLORED REDWING.

(*Agelaius gubernator californicus.*)

The bicolored redwing is distributed locally over a large part of California, but owing to its peculiar habit of building its nest directly over water, the areas it occupies are restricted. Flooded marshes and ponds overgrown with bulrushes or tules are much to its taste, affording abundant nesting sites. Such places are common in California and many are of large extent—as those on Suisun Bay and in the Sacramento and San Joaquin valleys. Among

these the bicolored redwing and his redwinged relatives find congenial quarters.

For the laboratory investigation of the food of this species, 198 stomachs were available. They were collected in every month of the year, and probably give a fair idea of the bird's food. It was found to consist of 14 percent of animal matter to 86 of vegetable. The animal food is practically all insects, and the vegetable either grain or weed seed.

Animal food.—Most of the animal food was taken in May, June, and July. May stomachs showed the maximum of nearly 91 percent. There is a sudden rise in the amount from April to May and a sudden fall from July to August. The insects composing this part of the food were distributed among several of the most common orders, but none of them appear to be specially sought after. Beetles aggregate about 5 percent. A few were predaceous ground beetles, but the most were either leaf beetles (Chrysomelidœ) or weevils. Hymenoptera, in the shape of wasps and ants, were taken very sparingly in the four months from May to August inclusive, and amount to about one-fourth of 1 percent for the year. Bugs were eaten during the six warmer months, and for the year aggregate just 1 percent. Grasshoppers constitute over 15 percent of the food in July. They are a fraction of 1 percent for the other months and average 1.5 percent for the year.

Caterpillars aggregate 5.5 percent, the highest of any item of animal food. In May they amount to over 45 percent of the food of that month, which is more than for all the other months together. Probably they are fed largely to the nestlings, as a few taken in May had eaten a large percentage of these insects. It is worthy of special notice that the caterpillar known in the cotton-raising States as the cotton bollworm, and elsewhere as the corn-ear worm, *Heliothis obsoleta,* was found in 7 stomachs. This is certainly to the credit of the bird, and it may be that its visits to cornfields are for this insect primarily, and that corn is taken only incidentally. A few miscellaneous insects amount to less than 1 percent and complete the animal portion of the diet.

The following are the insects identified in stomachs of the bicolored redwing:

COLEOPTERA.

Elaphrus ruscarius.
Gastroidea cyanea cæsia.
Chætocnema minuta.
Systena ochracea.
Notoxus alamedæ.
Apocrypha dyschirioides.

LEPIDOPTERA.

Heliothis obsoleta.

Vegetable food.—Two prominent constituents make up the vegetable food of the redwing—grain and weed seed. Grain amounts to 70 and weed seed to 15 percent. The grain consists of corn, wheat, oats, and barley. Oats are the favorite. They amount to over 47 percent of the yearly food, and were eaten in every month except February, when they were replaced by barley. The month of maximum consumption was December, when nearly 72 percent was eaten, but several other months were nearly as high. Wheat stands next to oats in the quantity eaten, nearly 13 percent. It is taken quite regularly in every month except March and May. Barley was found only in stomachs taken in February, October, and November, and nearly all of it was taken in February. The average for the year is 5.5 percent. Corn is eaten still less than barley, and nearly all was consumed in September, when it reached nearly 46 percent of the month's food. A little was eaten in May, August, and October, but the aggregate for the year is only slightly more than 4 percent.

Weed seed amounts to 15 percent of the food of the bicolored redwing. It is eaten in every month except May, when it gives way to animal food. The following species were identified:

Sunflower (*Helianthus* sp.).
Tarweed (*Madia sativa*).
Bur clover (*Medicago denticulatum*).
Alfilaria (*Erodium cicutarium*).
Red maids (*Calandrinia menziesi*).
Pigweed (*Amaranthus retroflexus*).
Chickweed (*Stellaria media*).
Catchfly (*Silene* sp.).
Smartweed (*Polygonum*).
Sorrel (*Rumex* sp.).
Canary seed (*Phalaris caroliniana*).
Sedge (*Carex* sp.).

These seeds were eaten very regularly throughout the year. The greatest consumption is in March, 35 percent, but as the record for several other months does not fall much below, probably this has no special significance. All of the above weeds are more or less of a nuisance, though at times some of them may be used as forage plants. Fruit is not eaten by the bicolored redwing.

Food of young.—Among the stomachs of the bicolored redwing were 11 of nestlings varying in age from 4 days to 2 weeks. The food was made up of 99 percent of animal matter and 1 percent of vegetable, though most of the latter was mere rubbish, no doubt accidental. Caterpillars were the largest item, and amounted to an average of 45 percent. Beetles, many of them in the larval state, stood next, with 32 percent. Hemiptera, especially stinkbugs and leafhoppers, amounted to 19 percent. A few miscellaneous insects and spiders made up the other 3 percent. It will be noted that the food of the young is practically all animal and that a preponderance of caterpillars and beetle larvæ makes it softer than that of the adults.

SUMMARY.

In summing up the facts relating to the food of the bicolored redwing, the most prominent point is the great percentage of grain. Evidently if this bird were abundant in a grain-raising country it would be a menace to the crop. But no complaints of the bird's depredations on grain have been made, and it is significant that the grain consumed is not taken at or just before the harvest, but is a constant element of every month's food. As the favorite grain is oats, which grows wild in great abundance, it must be admitted that, with all its possibilities for mischief, the bird at present is doing very little damage. So far as its insect food goes, it does no appreciable harm and much good. Its consumption of weed seed is a positive benefit. Like the other redwings, it has interesting habits and a pleasant song, and for the present, at least, should be protected.

OTHER REDWINGS.

In addition to the stomachs of the bicolored redwing, a few of 2 other species of redwings have been examined. They comprise 16 stomachs of the tricolored redwing (*Agelaius tricolor*), and 12 of the western redwing (some form of *A. phœniceus*). From the examination of so small a number, final data on the food can not be obtained, but so far as the testimony goes, it indicates that both species consume more insects and less grain than the bicolored. The stomachs of the tricolored contain 79 percent of animal matter to 21 of vegetable. The animal matter consists mostly of beetles and caterpillars, with a decided preponderance of caterpillars. The vegetable food is nearly all weed seed. One stomach alone contained barley.

In the case of the western redwings, the animal food amounted to 63 percent to 37 of vegetable. The former was pretty evenly distributed among beetles, grasshoppers, and Lepidoptera (moths and caterpillars), and contained in addition a few aquatic insects. The vegetable food was largely weed seed. A little barley was found in one stomach, and one was filled with oats.

It is evident from the foregoing that the beneficial greatly outweigh the injurious elements in the food of these redwings.

BREWER BLACKBIRD.

(*Euphagus cyanocephalus.*)

The Brewer blackbird (Pl. IV) occurs over most of the cultivated districts of California. By choice it is a resident of fields, meadows, orchards, and about ranch buildings and cultivated lands generally. It takes the place on the Pacific coast occupied by the crow blackbird (*Quiscalus quiscula* and *æneus*) in the Mississippi Valley and farther

east, and is so similar in appearance and habits that the eastern observer in California forgets that it is not the same species. It nests in bushes, weeds, and sometimes in trees, and is so gregarious that several nests are often built in the same vicinity. Large colonies frequently establish themselves near farm buildings, and feed freely in the stock yards and cultivated fields. When fruit is ripe these blackbirds do not hesitate to take a share, and they visit the orchard daily for the early cherries.

They claim a share of grain also, but do not appear to eat it at harvest time so much as afterwards. Mr. Walter K. Fisher, writing from Stockton, Calif., on November 12, 1897, reports them as feeding on newly sown wheat that had not been harrowed in, eating nearly all thus left exposed. He describes the birds as in such immense flocks in the grain fields that at a distance they looked like smoke rising from the ground, and says that stomachs of birds taken were full of wheat. On the other hand, Prof. A. J. Cook, of Claremont, Calif., says that he considered it one of the most valuable species in the State; and Mr. J. F. Illingsworth, of Ontario, Calif., in a paper read before the Pomona Farmers' Club,[a] speaks of it as a beneficial bird, which should be protected. Mr. O. E. Bremner, State horticultural inspector, in a letter to the Biological Survey, says:

> The cankerworm episode is quite a common one with us here. In one district, Dry Creek Valley, Sonoma County, there has been a threatened invasion of the prune trees by spring cankerworms several times, but each time the blackbirds came to the rescue and completely cleaned them out. I have often seen bands of blackbirds working in an infested orchard. They work from tree to tree, clearing them out as they go. If a worm tries to escape by webbing down, they will dive down and catch him in mid-air.

During the cherry season the writer observed these birds in the orchards, and collected a number of them. They were seen to eat freely of cherries, and the stomachs of those taken showed that a goodly proportion of the food consisted of cherry pulp. While these observations were being made, a neighboring fruit raiser began to plow his orchard. Almost immediately every blackbird in the vicinity was upon the newly opened ground, and many followed within a few feet of the plowman's heels in their eagerness to get every grub or other insect turned out by the plow. On another occasion an orchard was being watched while the far side was being plowed. A continual flight of blackbirds was passing in both directions over the observer's head, and practically all of them alighted on the newly plowed ground, fed there for a while, and then returned, probably to their nests. When plowing was finished and harrowing began, the blackbirds immediately changed their foraging ground, and followed the harrow as closely as they had accompanied the plow.

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[a] Ontario Observer, June 3, 1899.

BREWER BLACKBIRD

In the laboratory investigation of this bird's food 312 stomachs were available. They were collected in every month in the year, and represent fairly the fruit and grain growing sections of the State from Santa Rosa southward. Many were taken in orchards and gardens when in the act of pilfering fruit or other products of husbandry. Besides adults, 29 nestlings of various ages are represented. The first analysis of the stomach contents gives 32 percent of animal matter to 68 of vegetable. The animal food consists of insects, spiders, sow bugs, snails, and eggshells.

Animal food.—The animal food attains its maximum in April, when it reaches 82 percent. From that time it slowly decreases until December, when it is only 5 percent, and then rises toward its maximum. The increase is very sudden from March to April. Beetles constitute over 11 percent of the food, and of these 2.5 percent are predatory ground beetles (Carabidæ). April is the month of greatest consumption of beetles, 29 percent, but no carabids are eaten in this month. In June 22.5 percent of beetles are eaten, of which 12 percent are carabids. The amounts eaten in other months are insignificant. The great bulk of the beetles eaten are the darkling beetles (Tenebrionidæ), which have much the same habit of living on the ground as the carabids, and are probably more abundant in California. One stomach was entirely filled with them. A few click beetles (Elateridæ) and some weevils were also eaten.

Hymenoptera (wasps, bees, and ants) were eaten to the extent of 1.7 percent of the food. Evidently blackbirds are too slow to catch often such agile creatures as wasps and bees. Hymenoptera were eaten in every month from March to November, inclusive. In June they amount to something over 7 percent, which is the maximum.

Bugs (Hemiptera) of various kinds are eaten from April to November to a small extent. They aggregate somewhat more than 1 percent for the year. In the month of greatest consumption, June, they reach only 5.5 percent. They belong mostly to the families of stinkbugs (Pentatomidæ) and shield bugs (Scutelleridæ). A black olive scale was found in one stomach. Flies (Diptera) were eaten to a slight extent from April to July inclusive, with a trace in October. The total for the year is only a little more than 1.5 percent. Like bees and wasps, flies are probably too quick to be easily caught.

Caterpillars and pupæ (Lepidoptera) reach the highest percentage of any item of animal food. They amount to nearly 12 percent, and are eaten in every month. April is the month when most are taken, over 38 percent, and the record for May stands nearly as high. They belong largely to the owlet moths (Noctuidæ), which comprise many of those pests generally known as cutworms. The cotton bollworm, or corn-ear worm (*Heliothis obsoleta*), was identified in 10 stomachs, and was probably contained in many more, but in a condition that

baffled recognition. The most interesting Lepidoptera were the pupæ of the codling moth, found in 11 stomachs, 4 of which belonged to adults, while the other 7 were from nestlings, whose food will be discussed farther on. An orchardist told the writer that at one time his trees became infested with cankerworms, which swarmed all over the orchard and were rapidly destroying the leaves, when the blackbirds came in great numbers from all quarters and fed upon the worms until they were practically exterminated.

Grasshoppers and crickets were taken from April to November, inclusive, and amount for the whole year to 3.5 percent of the diet. In June they constitute over 15 percent of the food of that month, but only a moderate percentage was eaten in the other months. It is rather remarkable that birds which feed so much on the ground should eat so few of these insects, but this species appears to be mainly a vegetable eater, and to get the larger part of its animal food in April, just at its reproductive season, before grasshoppers are abundant.

Following is a list of insects identified in the stomachs of the Brewer blackbird:

COLEOPTERA.

Trisæna scitula.
Trisæna longula.
Bradycellus rupestris.
Scymnus lacustris.
Dermestes mannerheimi.
Saprinus obscurus.
Anchastus cinereipennis.
Aphodius rugifrons.
Aphodius granarius.
Diabrotica soror.
Diachus auratus.
Gastroidea sp.
Blapstinus pulverulentus.
Blapstinus rufipes.
Apocrypha dyschirioides.
Anthicus punctulatus.
Sitones sp.

HEMIPTERA.

Saissetia oleæ.

LEPIDOPTERA.

Heliothis obsoleta.
Carpocapsa pomonella.

Vegetable food.—The vegetable food reaches its maximum of 95 percent in December, when animal food is least plentiful. It may be divided into fruit, grain, and weed seed. Fruit was eaten in May, June, and July, not a trace appearing in any other month. It was found in 63 stomachs, of which 37 contained cherries (or what was thought to be such); 2, strawberries; 3, blackberries or raspberries; and 21, fruit pulp or skins not further identified. The percentages for each month were 14 for May, 22 for June, and 15 for July, an average of 17 percent for each of the three months, or of a little more than 4 percent for the whole year. This certainly is not a bad showing, and if the bird does no greater harm than is involved in its fruit eating, it is well worth protecting.

Grain constitutes 54 percent of the yearly food of the Brewer blackbird. It is eaten in every month, and forms a respectable percentage in each. The greatest amount is taken in December, 93 percent, and the least in April, 4 percent. Oats are the favorite grain. They amount to nearly 46 percent, and were found in 157 stomachs. Wheat amounts to nearly 3 percent, and was contained in 11 stomachs. Corn ranks next as to quantity eaten, less than 2 percent, but it was found in 17 stomachs. Barley occurred in only 5 stomachs, but amounted to a little more than 2 percent. Only 1 stomach held rye, but it amounted to more than 1 percent, for the stomach was nearly filled with it. Oats were the sole contents of 14 stomachs and wheat of 2. No stomach was completely filled with any other grain. Oats are evidently the favorite grain, whether we judge by the percentage eaten or by the number of stomachs containing them. Many of these were wild oats and of little economic value.

Weed seed amounts to nearly 9 percent of the food, and, while not consumed in large quantities, is eaten to some extent in every month. The greatest amount is taken in March, 26 percent. October comes next, with nearly 16 percent. The least is eaten in December and January, when grain is at its highest point. But little weed seed is eaten in May and June, when cherries demand attention. Weed seed was found in 134 stomachs, but in rather small quantities in each. No stomach was completely filled with it. It seems to be taken, moreover, rather irregularly, as though it were merely a makeshift. A few other odd items, mostly rubbish, amount to less than 1 percent, and complete the quota of vegetable food.

Seeds of the following uncultivated plants were identified:

Lesser tarweed (*Hemizonia fasciculata*).
Tarweed (*Madia sativa*).
Bur thistle (*Centaurea melitensis*).
Alfilaria (*Erodium cicutarium*).
Black mustard (*Brassica nigra*).
Miners' lettuce (*Montia perfoliata*).
Red maids (*Calandrinia menziesi*).
Pigweed (*Amaranthus retroflexus*).
Spurry (*Spergula arvensis*).
Chickweed (*Stellaria media*).
Catchfly (*Silene* sp.).
Knotweed (*Polygonum* sp.).
Brome grass (*Bromus* sp.).
Wild oats (*Avena fatua*).
Monterey pine (*Pinus radiata*).

Food of young.—Among the stomachs examined were those of 29 nestlings, varying in age from twenty-four hours to some that were nearly fledged. Taken altogether, the stomachs contained 89 percent of animal matter to 11 of vegetable. Over 74 percent of all was composed of caterpillars, grasshoppers, and spiders. Beetles in general amount to 6 percent of the food, or a little more than half the quantity eaten by the adults. Very singularly, however, 4.5 percent of these are carabids, or predatory ground beetles, nearly twice as many as are taken by the parent birds, although soft food is usually preferred for feeding nestlings. Caterpillars, with a few

adult moths and some pupæ, aggregate 33 percent, which is three times as many as were eaten by the old birds. They were found in 22 of the 29 stomachs. The most interesting part of this item is 15 codling moth pupæ that were contained in 7 stomachs. Four adult stomachs also contained one each of these pupæ, but they seem to be mostly reserved as tidbits for the young. Grasshoppers and crickets were found in 21 stomachs, and aggregate 30 percent of the food, more than eight times as much as was eaten by the adults, so these insects also are evidently reserved for the nestlings. Spiders amount to 11 percent of the food of the young, although less than 1 percent of the parents' food. Various other insects and a few snails make up the rest of the animal food.

The vegetable food consists of fruit, grain, and rubbish. Fruit, probably cherries, was found in 4 stomachs of one brood. The average for each stomach was 43 percent. This was the oldest brood taken, and the birds were nearly ready to fly, which probably accounts for the large proportion of vegetable food. Oats, found in the stomach of one bird about a week old, amounted to about 45 percent of the contents, and seemed unusual food for so young a bird. The other two of the same brood had grass and other rubbish in their stomachs. Rubbish is the best term to describe the vegetable matter in most of these stomachs. The fruit and grain were all that should be called food.

One can not fail to notice the very pronounced difference in diet between these nestlings and the adults. Not only is the animal food of the young greatly in excess, but it is practically made up of spiders, caterpillars, and grasshoppers. All of these are comparatively soft-bodied creatures, and probably on that account are selected for the young.

SUMMARY.

In so far as its animal food is concerned, but little fault can be found with the Brewer blackbird. The insects eaten are fairly well distributed among the various orders, and include only a comparatively small number that are useful. As to fruit, no more is eaten than may be considered a fair return for the destruction of insects. The weed seed eaten must be set down to the bird's credit. All question, then, in regard to its economic position must rest upon the grain it eats. Most of the grain is taken in the months from August to February, inclusive. The average amount consumed in those seven months is over 75 percent of the food, while the average for the other five months is less than 24 percent, yet this last period covers the time from sowing to the end of harvest. As matters stand at present, probably the bird is doing no harm by eating grain, except perhaps under exceptional circumstances. It has a decided

proclivity for oats, and if abundant would undoubtedly prove a menace to the crop.

WESTERN MEADOWLARK.

(*Sturnella neglecta.*)

Throughout California wherever grassy uplands, fields, and meadows occur, there will be seen the western meadowlark. Low, rich meadows, verging to marsh, with water near by, form ideal conditions for this bird. Nor does it disdain fertile hillsides when not too high, and when covered by a thick coat of herbage. Only professional ornithologists take note of the plumage differences between the eastern and western species of the meadowlark, but the difference in song is evident to the dullest ear. Owing to the snow, meadowlarks in the northern and eastern parts of the United States must migrate in winter far enough south to find open ground, but in California valleys no such necessity exists; so the bird remains on the same range the year round, and carries on its good work of destroying insects and weeds.

A few complaints have been made that meadowlarks in California eat the seeds of forage plants, notably clover, to an injurious extent. As most of the forage plants, including the introduced grasses of the Pacific coast lowlands, are annuals, the destruction of their seed would lessen the next season's feed and be a damage. Probably, however, such harm is done only under exceptional circumstances, for the stomachs show only a very small percentage of seed of forage plants and no clover seed. Another report is that the meadowlark does considerable damage to peas. The earliest fields are most visited by the birds, and small patches are sometimes almost completely destroyed. The later crops are not so badly damaged, and in extensive areas the loss is hardly noticeable. All the reports of damage to peas thus far received are from southern California, and very likely the explanation lies in some peculiar local conditions. The birds evidently lose their taste for this kind of food before the season is over, and probably find something more palatable which is wanting at first.

In some parts of the San Joaquin Valley the meadowlark has been accused, and probably with good reason, of pulling up sprouting grain in early spring. It is stated that the bird bores down beside the new plant and draws out the kernel. In many cases the amount of grain thus destroyed is said to be large. In one instance it was stated that the crop over a limited area was reduced 50 percent. The evidence, however, is conflicting, as some grain growers in the same localities are not aware of any loss. It thus seems probable that the damage to grain by the meadowlark is limited in extent and very local.

For the determination of the food of the meadowlark 91 stomachs were available, distributed throughout the year. The food consists of 70 percent of animal matter to 30 of vegetable. Broadly speaking, the animal matter is made up of insects and the vegetable of seeds.

Animal food.—Beetles are the largest item of the animal part of the diet. They are evidently a favorite food, for they are eaten in every month, with a good percentage in nearly all of them. The amount for the year is almost 27 percent. Practically half of this consists of the predatory ground beetles (Carabidæ). It is not surprising that the meadowlark should eat these beetles, for nearly all of them live on the ground, and walk and run much more than they fly; hence they are easily taken. As nearly all the species subsist largely upon other insects, their destruction must be considered as a flaw in this bird's record. All the other beetles eaten are harmful or neutral, and include a number of weevils. One stomach contained 36 yucca weevils (*Rhigopsis effracta*). The greatest number of beetles appears to have been eaten in March, when they amount to 72 percent, but as only two stomachs were available for that month the record is unreliable.

Wasps and ants (Hymenoptera) aggregate nearly 6 percent. They were eaten in every month but two, and ample material would undoubtedly show them in every month. Ants, being the more terrestrial, seem to be more natural food for the meadowlark than wasps or bees, but the bird gets a good share of both. Bugs (Hemiptera) were eaten to the extent of a little more than 4 percent. Nearly all of them were stinkbugs (Pentatomidæ). They were not eaten very regularly, and several months were not represented. May was the month of greatest consumption, 27 percent, but this may have been accidental.

Lepidoptera, largely caterpillars, aggregate about 15 percent. They were eaten in every month except August, when they were replaced by grasshoppers. February is apparently the month of maximum consumption, but a greater number of stomachs might prove differently. It is thought that many of these are of the kinds known as cutworms, though none were positively identified. All were undoubtedly terrestrial species, for the meadowlark is not known to seek food anywhere but on the ground.

Grasshoppers, when abundant, are usually eaten very freely by all ground feeding birds and by many arboreal species. The western meadowlark eats them to the extent of something more than 12 percent of its yearly food. This is a very small percentage for a bird of such terrestrial habits. The eastern form eats them to the extent of 29 percent, and in August the amount taken reaches 69 percent of the food of that month. With the western species the consumption reaches 42 percent in August, which is the maximum

for the year. In the East the grasshopper season is limited to five months at most, but in California these insects can always be found. This makes it all the more surprising that California meadowlarks do not eat them more freely, but it is noteworthy that nearly every species of terrestrial bird in the East eats a larger percentage of these insects than does the related species on the Pacific coast. The actual percentage of grasshoppers proper eaten by the western meadowlark is even less than the above figures indicate, for the record includes quite a number of crickets, both the black and the brown or wood crickets (*Stenopelmatus*). One stomach contained 12 wood crickets. Crane flies (Tipulidæ), spiders, sowbugs (*Oniscus*), and a few snails make up the rest of the animal food, nearly 6 percent. More than half of this item consists of the crane flies (daddy longlegs) found in one stomach taken in April, in which they amounted to 45 percent of the stomach's contents.

The following insects were identified in the stomachs of the western meadowlark:

COLEOPTERA.

Calosoma externum.
Trixena longula.
Silpha ramosa.
Dolopius lateralis.
Taphrocerus gracilis.
Eurymetopon cylindricum.
Blapstinus dilatatus.
Rhigopsis effracta.
Sitones hispidulus.

ORTHOPTERA.

Stenopelmatus sp.

Vegetable food.—The vegetable food of the western meadowlark may be arranged under three heads: Fruit, grain, and weed seed. In one stomach taken in November was found something which was doubtfully identified as fruit pulp, but no other stomach contained a trace of fruit, and this bird has rarely been accused of eating fruit.

From August to March inclusive, grain is one of the most important articles of food. The average monthly consumption for the year is 27.5 percent, but for the eight months just indicated the average is 41 percent. In the other four months, that is, from April to July inclusive, which include the ripening and harvesting of the crop, no grain except a little corn was eaten. Grain of some kind was found in 60 of the 91 stomachs, and 4 were entirely filled with it. Corn is eaten only occasionally, and amounts to but 1 percent of the food. It was all taken in May and June. Wheat was eaten from October to January, inclusive. It amounts to over 11 percent for those months, but to less than 4 percent for the whole year. As is usual with grain eating birds, oats are the favorite kind. They were eaten from August to March inclusive, and average nearly 33 percent for those eight months, and for the year a little less than 22 percent. The greatest quantity, nearly 57 percent, was eaten in January, but

nearly as much was taken in September. March, the month of seeding, shows the least, 10 percent. Barley was found in 6 stomachs taken in November, and amounts to less than 1 percent for the year.

Weed seed forms only 2 percent of the yearly food of the western meadowlark. With the eastern bird it aggregates a little more than 11 percent. It seems strange that a bird which obtains its food from the ground, and whose vegetable diet consists so largely of seeds, should neglect a food that furnishes sustenance to so many other species of birds. Weed seed was eaten so irregularly as to indicate that it was taken only as a makeshift. December was the month of greatest consumption, when it amounted to 15 percent.

SUMMARY.

Three items of damage may be brought up against the meadowlark. The first is the destruction of predaceous ground beetles (Carabidæ), which amount to one-eighth of its food. This, however, constitutes but a small offense when we consider the number of caterpillars and grasshoppers which the bird also destroys. The damage to peas and grain when sprouting are undoubtedly real and in some cases serious, but the conflicting testimony in regard to these points indicates that this damage is due to local conditions, and it is probable that a careful study of the attendant circumstances will lead to a remedy.

In some communities, especially in the South and West, where meadowlarks are most abundant, there is a tendency to include them among game birds. The tiny body of the meadowlark, however, has slight food value as compared with the value of the living bird to the agriculturist. While the western meadowlark can not be classed in the front rank of the proved friends of the farmer, its services are sufficiently real and important to earn protection wherever it is found.

BULLOCK ORIOLE.

(*Icterus bullocki.*)

Over most of the plains and valleys of California, where trees are available for nesting and foraging, the Bullock oriole (Pl. V.) is a common summer visitant. In the West it takes the place occupied in the East by the Baltimore oriole. In food, nesting habits, and song the birds are similar. Both are migratory and remain on their summer range only about five or six months. They are rather domestic in habits, and take kindly to orchards, gardens, and the vicinity of farm buildings, and often live in villages and in the parks of large towns. Their diet is largely made up of insects that infest orchards and gardens. Their favorite foraging places are trees, where they may be seen examining every leaf in search of their customary food,

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BULLOCK ORIOLE

caterpillars and other leaf-haunting insects. When fruit trees are in bloom they are constantly busy among the blossoms, and probably save many of them from destruction.

For the investigation of the food of the Bullock oriole 162 stomachs were available. They were taken in the five months from April to August inclusive, and probably give a very fair idea of the food for those months. Analysis of the contents shows about 79 percent of animal matter to 21 of vegetable.

Animal food.—The animal food consisted mainly of insects, with a few spiders, a lizard, a mollusk shell, and eggshells. Beetles amounted to 35 percent, and all except a few ladybugs (Coccinellidæ) were harmful species. The coccinellids were found in 9 stomachs, but the percentage was insignificant. Many of the beetles were weevils, and quite a number belonged to the genus *Balaninus*, which lives upon acorns and other nuts. Ants were found in 19 stomachs, and 1 contained nothing else. Hymenoptera other than ants were found in 56 stomachs, and entirely filled 2 of them. Including the ants, they amount to nearly 15 percent of the food of the season. The month of maximum consumption was April, when they reached over 29 percent of the monthly food.

One of the most interesting articles of food in the oriole's dietary is the black olive scale (*Saissetia oleæ*). This was found in 45 stomachs, and amounted to 5 percent of the food. In one stomach these scales formed 87 percent of the contents; in another, 82; and in each of two others, 81 percent. In one of these 30 individual scales could be counted. Scales were evidently a standard article of diet. They were eaten regularly in every month of the oriole's stay except April. Hemiptera other than scales are eaten quite regularly. They amount to a little more than 5 percent of the food. The month of greatest consumption was July, when they formed over 13 percent. They were mostly stinkbugs, leafhoppers, and tree hoppers. Plant lice (Aphididæ) were found in one stomach.

Lepidoptera, in the shape of moths, pupæ, and caterpillars, are the largest item of the oriole's animal food. April, the month of the bird's arrival from the South, is the month of greatest consumption, nearly 63 percent. The month when the fewest are taken is July, not quite 8 percent. This also is the month when the Baltimore oriole eats the fewest caterpillars. For the Bullock oriole the average consumption during its summer stay is a little more than 41 percent against 34 percent by the Baltimore. Perhaps the most interesting point in connection with the Lepidoptera is the eating of the pupæ and larvæ of the codling moth (*Carpocapsa pomonella*). These were found in 23 stomachs, which shows that they are not an unusual article of diet. No less than 14 of the pupa cases were found in one stomach, and as they are very fragile, many others may have been

present, but broken up beyond recognition. It is curious that the oriole should find these insects. During the greater part of their larval life they are concealed within the apple. When ready to pupate they crawl out and at once seek some place of concealment, such as a crevice in bark or among clods or rubbish, where they can undergo their changes. To find them, therefore, birds must hunt for them. This would be very natural work for woodpeckers, titmice, creepers, and nuthatches, but it seems a surprising habit for an oriole.

Grasshoppers probably do not come much in the oriole's way. They were eaten, however, to the extent of a little more than 3 percent. In June they rise to somewhat more than 11 percent, which is the maximum. August is the month in which most birds eat the greatest quantities of grasshoppers, but none of the orioles collected in that month had eaten any. In spite of the fact, however, that grasshoppers are eaten so sparingly, 2 stomachs, both taken in June, contained nothing else, and another had 97 percent of them.

Various insects and spiders, with a few other elements, make up the rest of the animal food, a little more than 5 percent. Spiders do not form any important percentage of the oriole's food, but are probably eaten whenever found. They were identified in 44 stomachs, but no great number appeared in any. The scales of a lizard were found in one stomach and the shell of a snail in another. Eggshells occurred in 8 stomachs, and one egg was apparently eaten when fresh.

Eggshells are often seen in birds' stomachs and in most cases are supposed to be empty shells, which have been thrown from the nest. In the examination of the stomachs of over 200 species of birds, eggshells have been found in some of the stomachs of a great majority of the species. While most of these may have been empty shells, some of the cases are very questionable, and it is probable that occasionally individuals of most species of birds yield to the temptation to eat a fresh egg when a favorable opportunity occurs.

Vegetable food.—Practically all of the vegetable food consists of fruit, which amounts to a little more than 9 percent. Other vegetable matter aggregating less than 2 percent is largely rubbish, probably taken accidentally. Fruit was eaten in the four months from May to August inclusive. The maximum quantity was taken in July, when it amounted to nearly 40 percent. It was found in 67 stomachs, of which 16 contained cherries; 11, figs; 5, blackberries or raspberries; 1, elderberries; and 34, fruit pulp not further identified. One stomach was entirely filled with the pulp and seeds of figs. While this is a high percentage of fruit, most of which is of cultivated varieties, it is probably well paid for by the destruction of harmful insects. It is doubtful if any fruit grower would be willing to sacri-

fice the oriole, with its brilliant plumage and cheerful song, even if it took more fruit than it now does.

SUMMARY.

From an esthetic point of view the Bullock oriole has few rivals, and from an economic standpoint it has only one fault—that it does eat some fruit. It is not, however, so abundant that its ravages are likely ever to become serious, and its present numbers should be strictly protected.

SPARROW FAMILY.

(*Fringillidæ.*)

The sparrow family embraces a large number of birds of wide distribution, great diversity of form, and considerable variation in food habits. They are in general characterized by short, stout, conical bills, with which they hull seeds or crush beetles and the toughest skinned fruit. They are the great seed eaters of the feathered race. The quantity of seeds of noxious weeds consumed by the host of sparrows, especially in winter, is enormous. While the great bulk of the food of this family consists of vegetable matter, most of the species eat some animal food during the period of reproduction, and feed their young upon it during the first two weeks of their lives. The sparrows proper, commonly known as finches, linnets, or buntings, are, with a few exceptions, of subdued colors and quiet habits and subsist mostly upon vegetable food. On the other hand, such aberrant forms as grosbeaks and towhees eat a certain amount of animal food throughout the year.

In California about 60 species and subspecies of sparrows proper have been recorded, besides about a dozen grosbeaks and towhees. Not all of these, however, have such habits as render them of economic importance, and as many of the subspecies do not differ essentially in their food they are treated together.

WILLOW GOLDFINCH.

(*Astragalinus tristis salicamans.*)

The willow goldfinch, while found over most of the State west of the Sierra, is very locally distributed. Its plumage is beautiful, and its song, while not remarkable for power or volume, is sweet and cheery. The western goldfinches, like the eastern, feed principally upon seeds, and seem to have a special taste for those of thistles. When one finds a ripe thistle head, he at once begins to pick out the seeds and scatter the down, at the same time making a great jubilation, as though he enjoyed the fun of seeing the down fly. This habit has earned for them the name of thistle bird. They are

eminently seed lovers, and rarely eat anything else, except a few insects during the season of reproduction. The only mischief so far imputed to them is the eating of the seeds of useful plants, such as lettuce and other vegetables on seed farms. Investigation has failed, however, to find a case where the damage was considerable. The writer visited some of the largest seed farms in California and ascertained that while birds, especially goldfinches, ate some of the ripening seeds, the damage had never been serious enough to warrant any protective measures. The writer observed goldfinches feeding on lettuce seed, but the birds were few, and all they could eat would have no appreciable effect on the quantity of seed harvested.

One marked peculiarity of the goldfinches is their bibulous habits. They seem always in need of water, perhaps owing to the habit of eating dry seeds. The writer has seen more goldfinches drinking in one day than he has seen of all other species in his whole life.

Only 84 stomachs of the willow goldfinch were available for examination, but such is the uniformity of the food that a larger number would probably not give a very different result. No stomachs were taken in December, but all the other months were represented. The food for those months amounts to 5 percent of animal matter to 95 of vegetable. All the animal food was found in 10 stomachs, 9 being taken in March, April, and May, and 1, containing 2 larvæ, in September. Practically all the vegetable matter is seeds.

Animal food.—The animal food was composed entirely of 3 orders of insects: Bugs (Hemiptera), flies (Diptera), and caterpillars (Lepidoptera). Bugs were contained in 5 stomachs and were all plant lice (Aphididæ). They aggregated a little less than 2 percent. Flies were found in 1 stomach taken in April. They were in the shape of larvæ or maggots and amounted to less than one-half of 1 percent. Caterpillars were contained in 6 stomachs and aggregated less than 3 percent. Beetles, wasps, ants, and grasshoppers, which so often constitute the bulk of the animal food of birds, are entirely wanting in the stomachs of the willow goldfinch, as also are spiders.

Vegetable food.—Vegetable matter appeared in every one of the 84 stomachs, and 73 of them held no other food. Hulls of oats were found in 1 stomach taken in May. It amounted to 65 percent of the contents of that stomach, and was the only thing of economic value found in any one of the 84 stomachs. It amounted to less than one-half of 1 percent of the year's food. Seeds of various weeds come to over 91 percent of the diet, and are found in every stomach in every month. For seven months weed seed constituted the entire food. The following plants were identified: *Centaurea* or bur thistle in 18 stomachs, alfilaria or filaree in 13, sunflower in 12, groundsel in 4, mouse-ear, rust weed, and tarweed in 2 each. As the goldfinch takes a good deal of gravel into its stomach, many of the seeds are ground

up so that recognition is impossible. A few stomachs contained a vegetable food that could not be identified, perhaps some large seed broken up and discolored. Two stomachs containing this substance were those of nestlings 12 days old. One was entirely filled with it, but the other contained 75 percent of caterpillars.

SUMMARY.

There are probably few birds that do so little harm as the willow goldfinch. Its animal food, though small in quantity, is composed entirely of harmful insects. It eats no fruit and practically no grain. Most of its food consists of the seeds of noxious or neutral plants. Its food habits commend the bird, as much as its bright plumage and fine song.

GREEN-BACKED GOLDFINCH.

(*Astragalinus psaltria hesperophilus.*)

The green-backed goldfinch (Pl. VI) occurs over most of California, except the mountains and the deserts, and is one of the most abundant birds. It is a lover of the orchard and garden, and delights to linger along the roads and in weed patches. Its favorite feeding grounds are in open pastures, where the bur thistle (*Centaurea melitensis*) grows, a plant specially adapted to the wants of the goldfinch, for it throws out from the roots short seed-bearing stalks that bear seed, while the rest of the plant is making growth and getting ready to produce the main crop. The goldfinches know where these seeds are, and apparently get every one of them. Next in favor is the groundsel (*Senecio*), which grows in orchards, and on the unripe seeds of which the goldfinches feed to repletion. In the investigation of the food of this bird 476 stomachs were examined. They were taken in every month, and are well distributed. Animal food amounts to 1.7 percent and vegetable food to 98.3.

Animal food.—Animal food was contained in 50 stomachs, all taken in the four months from June to September inclusive, except one, which was taken in November. This stomach contained 20 percent of some insect food, apparently flies. In one stomach taken in September beetles formed 1 percent of the contents. No other trace of a beetle was found. A small wasp or bee was identified in one stomach, also taken in September. It amounted to 2 percent of the contents and was the only hymenopterous insect found. Caterpillars amount to only a small fraction of 1 percent, and were contained in 2 stomachs, one taken in June and the other in July.

The great bulk of the animal food was made up of Hemiptera in the form of plant lice. These were found in 46 stomachs distributed through the four months from June to September inclusive, though more than half of them were taken in August. One stomach was

entirely filled with these insects, and in another 300 were counted. Considered in relation to the food of the year, however, they amount to only 1.6 percent. Many of these plant lice are of the kind commonly called woolly aphids, because their bodies are covered with a white cottony appearing substance, really a white wax, which exudes from the body of the insect. While the destruction of this small number of insects may seem insignificant, yet the goldfinch is one of the forces that keep within reasonable bounds the immense swarms of these prolific and pestiferous creatures. By far the greater number of these aphids were found in the crops and not in the stomachs; but as many of the latter were not accompanied by the crops, possibly the goldfinch consumes many more of these insects than is shown above. Then, too, aphids are very fragile, and by the time they reached the stomach many of them were probably too much reduced to be identified.

Vegetable food.—The vegetable food may be divided into 4 categories: Fruit, grain, weeds, and miscellaneous matter. Fruit was found in 7 stomachs, all taken in June, July, and August. In one case it was a berry with small seeds, which have not yet been identified; in the others it could be classed only as fruit pulp. Altogether it amounts to three-tenths of 1 percent of the year's food. A single kernel of wheat was found in 1 stomach taken in December. Weed seed is the standard food of this goldfinch. It aggregates over 96 percent of the year's diet, and in January and March nothing else is eaten. The month of least consumption, August, shows over 86 percent, and in every other month it is above 94. While several species are eaten freely, the chief is the Napa, or bur thistle (*Centaurea melitensis*), which was found in 243 of the 476 stomachs, and would seem to be the staff of life of the goldfinch. It is a small hard seed covered with an apparently siliceous shell, with a hook at one end and a bunch of stiff bristles at the other.[a] Generally the bird skillfully removes this shell and swallows only the starchy pulp. Many kinds of weed seed were found in the 469 stomachs examined, and only 7 did not contain any; 394 contained nothing else.

Other vegetable food, some of it not satisfactorily identified and some of it rubbish, amounts to 1½ percent of the whole. In regard to eating seeds of garden vegetables on seed farms, what was said of the willow goldfinch will apply with equal truth to this species. What seemed to be the petals of flowers were found in a few stomachs, but did not reach a respectable percentage. It does not appear that the green-backed goldfinch requires any other food than weed seed, and of this one or two varieties suffice. The following is a list

[a] Pl. II, fig. 1, Part I, opp. p. 16.

GREEN-BACKED GOLDFINCH

of the seeds identified and the number of stomachs in which each species was found:

Sunflower (*Helianthus* sp.)	4
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	23
Mayweed (*Anthemis cotula*)	10
Groundsel (*Senecio vulgaris*)	33
Bur thistle (*Centaurea melitensis*)	243
Black nightshade (*Solanum nigrum*)	1
Turkey mullein (*Eremocarpus setigerus*)	18
Alfilaria (*Erodium cicutarium*)	9
Black mustard (*Brassica nigra*)	1
Miner's lettuce (*Montia perfoliata*)	2
Red maids (*Calandrinia menziesi*)	1
Pigweed (*Amaranthus retroflexus*)	30
Chickweed (*Stellaria media*)	3
Catchfly (*Silene* sp.)	1
Knotweed (*Polygonum* sp.)	2
Sorrel (*Rumex* sp.)	1
Sedge (*Carex* sp.)	6

SUMMARY.

If there are any faults in the food habits of the green-backed goldfinch, the writer does not know them. The little animal food it consumes consists of harmful insects, and practically all of its vegetable food consists of seeds of useless or harmful weeds. This goldfinch should be protected to the fullest extent.

INTERMEDIATE AND NUTTALL SPARROWS.

(*Zonotrichia leucophrys gambeli* and *nuttalli*.)

One or the other of these two subspecies of the white-crowned sparrow is found throughout the year in some part of California, and in winter the intermediate (*gambeli*) is distributed nearly all over the lower parts of the State. These sparrows frequent valleys, brushy hillsides, highways, and cultivated fields. The only complaint against them is that in spring and in winter they eat buds of fruit trees. Buds are usually overabundant, and the loss of some is generally a benefit to the tree; in any event it would require a very thorough disbudding to do much damage.

For the investigation of the bird's food, 516 stomachs were available, taken in every month of the year, though August was represented by only one, and May and July by two each. The first analysis gives 7.4 percent of animal matter to 92.6 of vegetable.

Animal food.—Beetles amount to 1.4 percent of the food. In June they reach nearly 8 percent, but in the other months are unimportant. Practically all of them are harmful. Hymenoptera amount to 1.9 percent. In June they reach over 16 percent, but in the other months

rise barely above 1 percent. They were contained in 66 stomachs, of which 48 held ants and 18 contained wasps and bees. Parasitic species were noted in several stomachs.

Hemiptera amount to one-half of 1 percent, and were identified in 11 stomachs, of which 5 contained black olive scales; 2, leafhoppers; 3, stinkbugs; and 1, a tree hopper. Caterpillars are the largest item of animal food and amount to about 3.5 percent. Most of them were eaten in July, when they constituted 37.5 percent of the food, but as only 2 stomachs were collected in that month, this record can not be taken as final.

Vegetable food.—Fruit amounts to 4.5 percent. It was eaten rather irregularly, but most of it from March to July, inclusive. A mere trace was found in stomachs taken in September and October. Elderberries were found in 5 stomachs, blackberries or raspberries in 3, figs in 3, cherries in 2, and in 1 a small berry not positively identified. The cherries were unripe and only partly grown. A little pulp was noticed that might have been from some larger fruit. The great bulk of it was taken in May, June, and July. Grain aggregates 8.6 percent. It was contained in 69 stomachs, as follows: Oats in 56, wheat in 7, barley in 5, and corn in 1. Most of it was eaten in the three winter months, a little in the fall and spring, but practically none in summer. Only 3.5 percent was eaten in March, which would seem to indicate that this bird does not devour the newly sown grain.

Like many other fringilline birds, white-crowned sparrows subsist largely on weed seed. It is eaten freely in every month, and amounts to 74 percent of the yearly food. June is the month of least consumption, 33 percent, but that is the month when the most insects and fruit are eaten. The 1 stomach taken in August was entirely filled with this food, and it was over 90 percent of the contents of those taken in September and October. Of the 516 stomachs only 38, or a little more than 7 percent, contained no weed seed.

Following is a list of the species identified and the number of stomachs in which each was contained:

Sunflower (*Helianthus* sp.)	3
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	34
Mayweed (*Anthemis cotula*)	75
Bur thistle (*Centaurea melitensis*)	38
Sow thistle (*Sonchus asper*)	4
Prickly lettuce (*Lactuca scariola*)	1
Nightshade (*Solanum nigrum*)	70
Senna (*Cassia* sp.)	7
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	1
Mountain lilac (*Ceanothus* sp.)	1
Poison oak (*Rhus diversiloba*)	12
Alfilaria (*Erodium cicutarium*)	45

Geranium (*Geranium dissectum*)	18
Black mustard (*Brassica nigra*)	3
California poppy (*Eschscholtzia californica*)	1
Miner's lettuce (*Montia perfoliata*)	29
Red maids (*Calandrinia menziesi*)	4
Purslane (*Portulaca oleracea*)	4
Pigweed (*Chenopodium album*)	12
Rough pigweed (*Amaranthus retroflexus*)	208
Spurry (*Spergula arvensis*)	10
Chickweed (*Stellaria media*)	16
Catchfly (*Silene* sp.)	29
Knotweed (*Polygonum* sp.)	76
Sorrel (*Rumex* sp.)	18
Brome grass (*Bromus* sp.)	20
Wild oats (*Avena fatua*)	34
Canary seed (*Phalaris canariensis*)	2
Johnson grass (*Andropogon sorghum*)	1
Sedge (*Carex* sp.)	11
Unidentified	168

As this bird takes a great deal of gravel, the seeds eaten are soon ground into paste, which renders specific identification impossible. Many stomachs were entirely filled with food in this condition, which accounts for the large amount of unidentified material. Very few whole seeds were unidentified. The white-crown is evidently fond of variety, for several stomachs contained as many as 9 different species of seeds. It will be noted also that rough pigweed is the favorite food, while the Arkansas goldfinch preferred bur thistle.

Miscellaneous vegetable matter amounts to 5 per cent, and was found in 30 stomachs. Of these, 11 contained fragments of flowers, probably of fruit trees, for in some cases the embryo fruit could be made out. This is not a very heavy indictment on the score of destroying buds and blossoms. Fibrous vegetable matter of uncertain origin was found in quite a number of stomachs; perhaps it was grass which had been subjected to the grinding action of the stomach.

SUMMARY.

Evidently neither the farmer nor the fruit grower has much to fear from the white-crowned sparrow. On the contrary the bird destroys some insects, all of which are harmful, and a vast number of seeds of noxious weeds. The little fruit it eats is mostly wild, and its grain eating is practically confined to the months when the only grain available is waste or volunteer. In the above record there is little to substantiate the accusation that the bird destroys fruit buds, and probably it is only under very exceptional circumstances that it does any damage in this way.

GOLDEN-CROWNED SPARROW.

(*Zonotrichia coronata.*)

The golden-crowned sparrow arrives in California from the north in September, and departs for its summer residence in April. In winter it spreads over the country, lives wherever food can be obtained, except perhaps in the forest, and may often be seen in the garden among the fruit trees or in the rose bushes. It is also found in lonely canyons or on the cattle ranges in the hills. In general appearance and in food habits it does not differ essentially from the white-crown. For the determination of its food 184 stomachs were available, taken from October to April, inclusive. The animal food amounts to 0.9 percent, vegetable to 99.1.

Animal food.—The animal food consists of insects, and is pretty well distributed among the various orders. No great quantity was found in any one stomach, and it is eaten so rarely and in such small quantities that the wonder is that it is eaten at all. Singularly enough two worker honeybees were found in one stomach. It is evident that the golden-crown does not search for insects, and takes only those that come in its way.

Vegetable food.—The vegetable food consists of fruit, buds and flowers, grain, and some miscellaneous matter. Fruit can not be a prominent item in the food of this sparrow, owing to the time of year it spends in California. One stomach taken in March contained a little fruit pulp, probably left over from the previous season. Fruit was found also in 2 stomachs taken in October and in 2 taken in November. In one it consisted of elderberries; in one, of grape; in another, it was thought to be apple; while in the fourth, it was unidentifiable. In all, it amounts to a little more than 1 percent of the food. Remains of buds and flowers were found in stomachs taken in every month of the bird's stay in the State, except October and November, when buds are very small. They were found in 56 stomachs; the average for the season is 29.5 percent, and in March it rises to nearly 78 percent. Where this bird is abundant, it may do mischief if it visits the orchards. In the stomach of no other species yet examined has been found so much of this kind of food, which makes it probable that much of the bud and flower eating imputed to the linnet and white-crown is really done by the golden-crown.

Grain was eaten during every month of the bird's stay in the State, but as none of these was a harvest month, little damage was done. March, the sowing month, showed but little more than 5 percent, while over 66 percent was eaten in January. The average for the season was nearly 26 percent. It was found in 23 stomachs, of which 12 contained oats; 6, wheat; 2, barley; 2, corn; and 1, doubtful.

Weed seed amounts to 33 percent of the food and is eaten in every month. It is, however, complementary to the bud and blossom food, the one increasing as the other decreases. Weed seed begins with a percentage of 83 in October, and gradually diminishes, while buds and blossoms appear first in December with 22 percent and increase to their maximum in April.

Below is a list of species identified, showing the number of stomachs in which each was contained:

Tarweed (*Madia sativa*)	11
Mayweed (*Anthemis cotula*)	15
Bur thistle (*Centaurea melitensis*)	18
Nightshade (*Solanum nigrum*)	16
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	2
Turkey mullein (*Eremocarpus setigerus*)	2
Poison oak (*Rhus diversiloba*)	30
Alfilaria (*Erodium cicutarium*)	16
Geranium (*Geranium dissectum*)	16
Mustard (*Brassica nigra*)	1
Rough pigweed (*Amaranthus retroflexus*)	18
Spurry (*Spergula arvensis*)	4
Chickweed (*Stellaria media*)	10
Catchfly (*Silene* sp.)	1
Knotweed (*Polygonum* sp.)	10
Sorrel (*Rumex* sp.)	10
Brome grass (*Bromus* sp.)	11
Sedge (*Carex* sp.)	1
Seeds of conifer	1
Unidentified	39

The last item includes stomachs in which the food was ground to a pulp, rendering identification impossible. Few whole seeds were unidentified. Poison-oak seeds are indicated as found in 30 stomachs, but as a matter of fact not a single seed of that plant was seen in any stomach. The birds ate only the wax which surrounds those seeds and which contains certain woody granules by which it can at once be identified. This species, then, does not aid in the dissemination of these noxious plants.

SUMMARY.

From the foregoing it is evident that the golden-crown during its stay in California does but little service in destroying insects. On the other hand, it does no direct harm to fruit, and little, if any, to grain. It does good by destroying weed seed, although not as much as some other species. By the destruction of buds and blossoms it may do serious harm where it is numerous and visits the orchards.

WESTERN CHIPPING SPARROW.

(*Spizella passerina arizonæ.*)

The western chipping sparrow occurs during the breeding season and early fall over most of the State, and winters sparingly in the southern part. Like its eastern relative it is very domestic, and often builds its nests in gardens and orchards. The bird well merits the name *socialis*, now, unhappily, superseded, and its gentle and confiding ways endear it to all bird lovers. It is one of the most insectivorous of all the sparrows, and is valuable in the garden or about the farm.

For the investigation of this bird's food 96 stomachs were available. They were taken from April to October inclusive, and probably give a fair idea of the food for that part of the year. It is quite likely that the winter food consists largely, if not entirely, of weed seeds, as 4 stomachs taken in the southern part of the State in winter (not included in this investigation) were almost entirely filled with this food. The first division of the stomachs' contents gives 45 percent of animal food and 55 percent of vegetable.

Animal food.—The animal food consists of insects and spiders, with a few bits of eggshell. Beetles were eaten from April to August inclusive, with the maximum of 23 percent in July. In one stomach were the remains of 30 weevils or snout beetles, but so badly crushed and broken that specific identification was impossible. The average monthly percentage is 6.7. Hymenoptera amount to 11.8 percent. They are represented mostly by ants, with which several stomachs were entirely filled. The greatest quantity were eaten in June, when they aggregated 67.5 percent, or more than four-fifths of the animal food for the month. In the other months they were taken rather irregularly and in small quantities.

Hemiptera are eaten to the average extent of 7.5 percent. They appear rather irregularly, and the greatest consumption is in October, 20 percent. None were found in August or September stomachs, but as only 4 were collected in October, and not many in the two previous months, the record can not be considered as fully reliable. They consist of stinkbugs and leafhoppers, with a few others, of which the most interesting are scales and plant lice. These were each found in 5 stomachs. The scales were the black olive species (*Saissetia oleæ*). Diptera, or flies, do not appear to be favorite food with the chipping sparrow. They were eaten only in the months from April to July inclusive, with the maximum consumption in May, when about 12 percent were taken, or more than half of all. The average per month is only 3 percent.

Caterpillars are evidently the favorite animal food, as they were eaten to an average extent of 14.7 percent, or more than any other

insect. They appear in the food during every month of the bird's stay in the north except October, and probably a greater number of stomachs would have shown some in that month. Two stomachs contained pupæ of the codling moth. Only one stomach held grasshoppers, and that was taken in June. Some spiders and eggshells make up nearly 1 percent, and complete the animal food.

Vegetable food.—Grain in the shape of oats was found in 5 stomachs, all collected in July. The total amount for that month is 6 percent, or less than 1 percent for the season. A mere trace of fruit was found in one stomach in June. Weed seed was eaten in every month of the bird's stay, and probably throughout the year. It amounts to over 53 percent of the food, and in September rises to 98 percent. June was the month of least consumption, 9 percent, when insects evidently took its place. The species identified, and the number of stomachs in which each was found, are as follows:

Bur thistle (*Centaurea melitensis*)	2
Nightshade (*Solanum nigrum*)	1
Alfilaria (*Erodium cicutarium*)	37
Miner's lettuce (*Montia perfoliata*)	3
Red maids (*Calindrinia menzeisi*)	2
Rough pigweed (*Amaranthus retroflexus*)	16
Chickweed (*Stellaria media*)	13
Knotweed (*Polygonum* sp.)	1
Timothy (*Phleum pratense*)	1
Meadow grass (*Poa* sp.)	1
Panic grass (*Panicum sanguinale*)	2
Wild oats (*Avena fatua*)	1
Sedge (*Carex* sp.)	2
Unidentified	32

Most of the unidentified seeds were so badly ground up that it was impossible to recognize the species. The greater part probably belonged to species included in the above list. A few very small grass seeds were not further identified.

Feeding the young.—A nest with 4 young of this species, about 6 days old when first observed, was watched at different hours on four days. On the morning of the fifth day a pair of jays carried off the young birds. In the seven hours of observation 119 feedings were noted, or an average of 17 feedings per hour, or four and one-fourth feedings per hour to each nestling. This would give for a day of fourteen hours at least 238 insects destroyed by the brood.

SUMMARY.

In the foregoing discussion of the food of the chipping sparrow it plainly appears that the diet is made up almost exclusively of harmful elements. No useful beetles of any consequence were eaten. Of Hymenoptera, ants, which are either harmful or neutral, predominate,

while caterpillars, which are a universal pest, are the favorite animal food. In the vegetable portion of the diet fruit and grain appear as mere traces, while the seeds of noxious weeds make up the bulk of the food. It is not necessary to further eulogize this bird, as it is already welcomed everywhere, as it should be.

WESTERN SNOWBIRD.

(*Junco hyemalis thurberi* and other subspecies.)

Several subspecies of junco occur in California. One form, *J. pinosus*, is a resident of the Monterey Bay region the year round. Another, *thurberi*, is a resident of the State throughout the year, but winters in the valleys and breeds in the mountains. Two others, *oreganus* and *connectens*, occur in winter only, when all the forms spread out and cover a considerable part of the State. It would be better to treat the four races separately, but as many of the stomachs were collected before the races were recognized, their exact identity is unknown. They will be discussed, therefore, as a whole, but what is said of summer food will not apply to *oreganus* and *connectens*.

For this investigation 269 stomachs were available. They were collected in every month except May. March, April, June, and August are poorly represented, but the other months have each a good quota. The first analysis of the food gives 24 percent of animal matter to 76 of vegetable.

Animal food.—Beetles amount to 5 percent, and nearly all were eaten in the months from March to July inclusive, with no record for May. With the exception of two ladybirds (Coccinellidæ) found in 2 stomachs, not a useful species was identified in the whole. Weevils make up the bulk of this item, and a species of scolytid (*Phlœosinus punctatus*) was found in 1 stomach to the extent of 65 percent of its contents. Hymenoptera were represented mostly by ants, with a few wasps, amounting in all to a little more than 2 percent of the food. Caterpillars are apparently the favorite insect food, forming 9.4 percent of the diet. The great bulk were eaten from April to August, and the single stomach taken in August contained 67 percent of them. No special pest was identified. Bugs, grasshoppers, a few other insects, and spiders, make up the remainder of the animal food, 7.3 percent.

Vegetable food.—Seeds of blackberry or raspberry were found in 1 stomach and elderberries in 2. In 14 stomachs taken in November was found fruit pulp averaging over 11 percent of the food of the month. As all fruit except olives is harvested before that time, probably the berries were of no value.

Grain was eaten from October to March inclusive, and amounted to 8 percent for the year. All of it was contained in 30 stomachs, as

follows: Oats in 15, wheat in 9, barley in 4, corn in 1, and unidentified in 1. None was taken in a harvest month. The greatest amount, more than 30 percent, was eaten in March, the sowing month, probably much of it from newly sown fields.

Weed seed aggregates 61.8 percent of the food, and was eaten in every month. In September it amounted to nearly 95 percent. A few seeds, mostly of grass, were not identified. The following is a list of identified species and the number of stomachs in which each was contained:

Ragweed (*Ambrosia* sp.)	1
Tarweed (*Madia sativa*)	4
Mayweed (*Anthemis cotula*)	11
Bur thistle (*Centaurea melitensis*)	16
Sow thistle (*Sonchus asper*)	2
Nightshade (*Solanum nigrum*)	11
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	1
Poison oak (*Rhus diversiloba*)	13
Alfilaria (*Erodium cicutarium*)	34
Geranium (*Geranium dissectum*)	4
Mustard (*Brassica nigra*)	3
Miner's lettuce (*Montia perfoliata*)	13
Red maids (*Calandrinia menziesi*)	2
Purslane (*Portulaca oleracea*)	1
Rough pigweed (*Amaranthus retroflexus*)	35
Spurry (*Spergula arvensis*)	9
Chickweed (*Stellaria media*)	42
Catchfly (*Silene* sp.)	21
Knotweed (*Polygonum* sp.)	33
Sorrel (*Rumex* sp.)	26
Wild oats (*Avena fatua*)	8
Timothy (*Phleum pratense*)	1
Panic grass (*Panicum* sp.)	3
Sedge (*Carex* sp.)	14
Coniferous seeds not identified	4
Unidentified	2

Remains of blossoms were found in 1 stomach. The seeds of poison oak were not discovered in the stomachs, but the characteristic granules that are embedded in the waxy coating of the seeds were identified, thus showing that the birds eat this wax without swallowing the seed itself.

SUMMARY.

The insect food of the snowbirds is composed almost entirely of harmful species, of which caterpillars form the largest item. Snowbirds do no damage to fruit or grain. They eat large quantities of weed seeds, thereby rendering a service to agriculture.

WESTERN SONG SPARROW.

(*Melospiza melodia samuelis*, *heermani*, and other subspecies.)

Song sparrows inhabit not only the greater part of California but all of the United States, except areas where conditions are unsuitable. These birds vary much in habits, as well as in size and coloration. Some forms live along streams bordered by deserts, others in swamps among bulrushes and tules, others in timbered regions, others on rocky barren hillsides, and still others in rich fertile valleys. Each area has its peculiar form, and in fact it is hard to imagine any locality adapted to a land bird of the Temperate Zone which does not fit some form of the song sparrow. With such a variety of habitat, the food of the species necessarily varies considerably. It is impossible to treat here the several forms separately, and the best we can do is to give a general idea of the yearly diet of the species as a whole.

For the investigation of the food of the western song sparrows, 321 stomachs, belonging to 4 or 5 subspecies, were available. They were collected in every month of the year, and fairly represent the whole State. The first analysis separates the food into 21 percent of animal matter and 79 of vegetable. This is less animal food than is eaten by the snowbird, much less than by the chipping sparrow, but much more than by the white-crowned or golden-crowned sparrows.

Animal food.—Animal food, consisting principally of insects, is eaten with a fair degree of regularity through the year. Beginning with a minimum of 3 percent in September, based on the examination of 97 stomachs, it rises gradually to a maximum of over 71 percent in May. Beetles are the largest item, and a greater or less number were eaten every month except December, an omission probably accidental. The average for the year is 6.6 percent. In June, the month of greatest consumption, nearly 29 percent were eaten. With the exception of the remains of tiger beetles (Cicindelidæ) in 3 stomachs and predaceous ground beetles (Carabidæ) in 10, all were of harmful families, the leaf beetles (Chrysomelidæ) and weevils (Rhynchophora) being most prominent.

Hymenoptera (bees, wasps, and ants) were taken very irregularly, and amount to only 3 percent of the food. Ants were found in 22 stomachs, and bees and wasps in 20. Hemiptera, or bugs, form only about 2 percent of the year's food, but 17 percent of the food eaten in May. The black olive scale was found in 2 stomachs and a species not identified in 1. Leafhoppers, spittle insects (Cercopidæ), and a few other forms make up the rest of this item. Diptera (flies) were eaten from May to September inclusive. In May they amount to over 11 per cent, but fall away rapidly, and the aggregate for the year is only 2 percent. A few crane flies (Tipulidæ) and the house fly family (Muscidæ) were the only forms recognized.

Caterpillars, while taken in nearly every month, were eaten very irregularly and to the extent of 4.3 percent only. There was a fair percentage from March to August inclusive, but in other months a trifle or none, except December, in which 5 percent were found. May shows the greatest amount, 14 percent. Grasshoppers are apparently not relished by the song sparrow. A mere trace of these insects was found in a few stomachs collected in February, May, June, and August. They do not form an appreciable percentage of the food. A few insects too finely pulverized for recognition, some spiders, and a few snails make up the remainder of the animal food, 2.5 percent.

Vegetable food.—Evidence of fruit eating was found in 19 stomachs as follows: Seeds of Rubus (blackberries or raspberries) in 9, elderberries in 4, cherries in 2, figs in 1, and fruit pulp or skins in 3. In all it amounts to a trifle more than 2 percent of the food. Grain was absent in all stomachs collected from February to June inclusive, and in November. What was eaten in the other months comes to a little more than 3 percent for the year. The most, 11 percent, was taken in January, but July shows very nearly the same. This last was perhaps gleaned from the field. The varieties are as follows: Barley found in 7 stomachs, oats in 5, and wheat in 2.

The chief food of the song sparrow is weed seed. This amounts to 73 percent of the year's food, and varies from one-fifth to very nearly the whole of each month's diet. In September, when animal food is at its minimum, weed seed reaches a little more than 93 percent. On the other hand, in May, when animal food is at its maximum, weed seed shrinks to a little less than 21 percent. Of the 321 stomachs, 302, or 94 percent, contained weed seed. Of these, 171, or 53 percent of all, were completely filled with it. There were only 19 stomachs that did not contain more or less of this food. The record of this sparrow for eating weed seed is excelled by only four species of California birds—the linnet, the two goldfinches, and the white-crowned sparrow.

Following are the species of weed seeds identified and the number of stomachs in which each was found:

Sunflower (*Helianthus* sp.)	1
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	9
Mayweed (*Anthemis cotula*)	7
Bur thistle (*Centaurea melitensis*)	36
Sow thistle (*Sonchus asper* and *oleraceus*)	5
Salsify (*Tragopogon porrifolius*)	1
Henbit (*Lamium amplexicaule*)	1
Nightshade (*Solanum nigrum*)	35
Nine bark (*Opulaster opulifolius*)	1
Turkey mullein (*Eremocarpus setigerus*)	1
Poison oak (*Rhus diversiloba*)	3
Alfilaria (*Erodium cicutarium*)	23

Geranium (*Geranium carolinianum*)	1
Mustard (*Brassica nigra*)	1
Miner's lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	6
Pigweed (*Chenopodium album*)	1
Rough pigweed (*Amaranthus retroflexus*)	113
Spurry (*Spergula arvensis*)	12
Chickweed (*Stellaria media*)	32
Catchfly (*Silene* sp.)	3
Knotweed (*Polygonum* sp.)	44
Sorrel (*Rumex* sp.)	16
Brome grass (*Bromus* sp.)	4
Wild oats (*Avena fatua*)	14
Timothy (*Phleum pratense*)	1
Canary seed (*Phalaris caroliniana*)	2
Fox tail (*Chaetochloa* sp.)	1
Panic grass (*Panicum sanguinale*)	4
Sedge (*Carex* sp.)	8
Unidentified	97

As usual, the unidentified were either ground to pulp or were seeds of some unknown grass. Evidently the rough pigweed seed (*Amaranthus*) is the favorite. Several stomachs contained nothing else.

SUMMARY.

The economic status of the song sparrow can be summarized in a few words. It eats a comparatively small number of insects, the majority of which are noxious. Fruit and grain are eaten so little as to be of no consequence. Nearly three-fourths of the diet consists of seeds of weeds, most of which are a nuisance. Neither stomach examinations nor field observations furnish evidence that the song sparrow does any harm.

SPOTTED TOWHEE.

(*Pipilo maculatus* and subspecies.)

Under one or other of its several subspecific forms the spotted towhee occurs almost throughout California. As it is resident over much of its range, the good or harm it does continues through the year. It is eminently a bird of the ground and underbrush, and delights in the thickest shrubbery, where it scratches among the dead leaves and twigs. Anyone who approaches the bushes too closely will probably see the bird depart from the opposite side and plunge into another thicket, and in this way one may chase it for hours with no more than an occasional glimpse. This bird is not common about orchard or garden, the chaparral-covered hillsides and canyons being more congenial resorts. It is abundant and widely distributed, and hence is comparatively important from an economic point of view.

For the investigation of the food of this bird 139 stomachs were at hand, collected in every month of the year, though November to May inclusive were not represented as fully as was desirable. The

first analysis of the food gives 24 percent of animal matter to 76 of vegetable. Dead leaves, bits of twigs, rotten wood, and other rubbish are very common in the stomachs, and probably are swallowed accidentally with more nutritious morsels.

Animal food.—Beetles are the largest item of animal food, and amount to a little more than 10 percent. Although the larger part of the towhee's living is gleaned from the ground, only 4 stomachs contained the remains of predaceous ground beetles, and 2 others the remains of ladybirds (Coccinellidæ). Weevils were found in 26 stomachs, and in 13 stomachs were the remains of that harmful chrysomalid beetle *Diabrotica soror*. Besides these were fragments of elaterids, buprestids, and cerambycids, all of which in the larval state bore into trees and other plants and do great mischief. Hymenoptera amount to 6 percent of the diet, but are eaten rather irregularly. They are mostly taken in summer, but some appear at all times of the year. They were found in 39 stomachs, of which 25 contained ants, and 14, wasps and bees.

Bugs (Hemiptera) amount to 14 percent, and are distributed among several families; but the only point that merits mention is that the black olive scale was found in 4 stomachs and an unidentified scale in 1. The spotted towhee does not appear to care for grasshoppers. They form only 1.7 percent of the year's food, and are eaten very irregularly. In June they reach a little more than 11 percent, in August they amount to only 6 percent, and few were found in other months. Caterpillars aggregate 3.5 percent of the food. They are eaten rather irregularly, without much regard to season, but the greatest number, 12 percent, were taken in April. A few flies, some other insects, spiders, millepeds, and sowbugs (*Oniscus*) make up about 3 percent, the remainder of the animal food. These last are just what the bird would be expected to get by scratching among underbrush.

Vegetable food.—Fruit was eaten in every month from May to November inclusive, with a good percentage in each month. January also shows 11.7 percent, but this was either wild or waste. The average for the year is 17.7 percent. The month of greatest consumption was November, when it amounted to 53.6 percent. All of it was in the shape of fruit pulp, not further identifiable. At that time of year it could have been of no value. Fruit pulp, identified only as such, was found in 23 stomachs. Rubus seeds and pulp (raspberries or blackberries) were found in 23 stomachs; cherries, grapes, and figs in 1 each. Elderberries (*Sambucus glauca*) were found in 6 stomachs, snowberries (*Symphoricarpos racemosus*) in 3, and black twinberries (*Lonicera involucrata*) in 1. The fruit eaten in June and July was almost entirely Rubus fruit, which may have been either wild or cultivated, except in one case, where the seeds of Logan

berries were identified. In August and September the fruit eaten was of the larger varieties, like apricots, peaches, and prunes. Later in the year the wild kinds only were taken. The one stomach which contained cherries was collected the last of May. If this bird were as abundant as the linnet, it would do considerable damage to the larger fruits. Under present conditions its depredations probably pass unnoticed.

Grain was eaten from June to December, inclusive, except in November. The amount for the year is 4.7 percent. In August, the month of greatest consumption, 16 percent was taken. It was found in 17 stomachs, of which 10 contained oats; 3, wheat; 3, corn; and 1, barley. As most of this was gleaned after harvest, probably no harm was done.

Weed seed is a standard article of diet with this bird, as with many others. It was found in 93 of the 139 stomachs, and 11 contained nothing else. The average amount for the year is 34.6 percent of the food, and it was found in every month except March; but as only one bird was collected in that month, the exception is probably accidental. January was the month when most was eaten, 62.8 percent, but as some other months stood nearly as high, this has no special significance. Bur thistle seems to be the favorite seed, although the towhee does not show so strong a preference for any weed as some other species exhibit.

Following is a list of species identified and the number of stomachs in which each was found:

Tarweed (*Madia sativa*)	10
Bur thistle (*Centaurea melitensis*)	27
Nightshade (*Solanum nigrum*)	8
Plantain (*Plantago lanceolata*)	1
Senna (*Cassia* sp.)	1
Clover (*Trifolium* sp.)	1
Legumes unidentified	3
Turkey mullein (*Eremocarpos setigerus*)	2
Poison oak (*Rhus diversiloba*)	11
Sumac (*Rhus* sp.)	1
Alfilaria (*Erodium cicutarium*)	11
Mustard (*Brassica nigra*)	1
Miners' lettuce (*Montia perfoliata*)	8
Red maids (*Calandrinia menziesi*)	2
Rough pigweed (*Amaranthus retroflexus*)	11
Chickweed (*Stellaria media*)	8
Knotweed (*Polygonum* sp.)	4
Sorrel (*Rumex* sp.)	5
Wild oats (*Avena fatua*)	9
Sedge (*Carex* sp.)	3
Unidentified	34

Another article of the towhee's food is mast. It is somewhat difficult to distinguish between mast and weed seed when both are ground to a pulp. As divided, however, mast amounts to 15.6 percent of the

food. It was found in moderate quantities in stomachs collected from September to February inclusive, and in April also it reached 25 percent, with a trace in June. February was the month in which most was eaten, 46.5 percent. It was found in only 22 stomachs, but 8 of them were completely filled with it. Leaf galls and some unidentified vegetable matter make up a little more than 3 percent, and complete the vegetable food.

SUMMARY.

The spotted towhee is not numerous enough to inflict any great damage, whatever its food habits. Should it become very abundant it might do harm to fruit; but it is so shy that the more the country is cleared and settled the more rare is it likely to become.

CALIFORNIA TOWHEE.

(*Pipilo crissalis* and *senicula*.)

In rural communities on the Pacific coast, the California towhee occupies a place similar to that of the robin in the east. It is quite domestic in habits, and not only is it a familiar sight about orchards and gardens, but it often builds its nest in the shrubbery and vines around the house. Its habits are somewhat more terrestrial than those of the robin, and the fruit it eats is largely that which it finds on the ground. Like the spotted towhee, it forages much under bushes and vines, scratching among the rubbish for food; however, it does not confine itself to such places, but frequents also the open ground, looking for insects and seeds. At such times a pair are almost invariably seen together. The species does not migrate. One or other of its subspecies inhabits most of the valley and foothill country of California west of the Sierra Nevada and San Jacinto mountains.

For the study of the bird's food 399 stomachs were available, collected in every month, with a fair number in each month. The first analysis gives 14.26 percent of animal food to 85.74 of vegetable. The animal food consists of insects and a few spiders, millepeds, and snails. The vegetable part is made up of fruit, grain, weed seeds, and a few miscellaneous substances.

Animal food.—The largest item of the animal food consists of beetles, which amount to 5 percent. The predaceous ground beetles (Carabidæ) were found in 30 stomachs, and were the only useful beetles eaten. Weevils, or snout beetles, were found in 55 stomachs, of which 1 contained 15. Among them was identified one specimen of *Calandra oryza*, the rice weevil, an insect that does much harm to rice. A decidedly harmful species of chrysomelid beetle (*Diabrotica soror*) was found in 43 stomachs. All the other beetles, which belong to several families, are harmful. While beetles were eaten in every month except December, the great bulk were taken from April

to July, inclusive. In June they amount to nearly 15 percent, which is the highest for any month.

Hymenoptera amount to less than 2 percent. They consist of ants found in 47 stomachs and bees or wasps in 23 stomachs. Hemiptera, or bugs, are eaten to a small extent in nearly every month, but do not reach a high percentage in any. The maximum, 6 percent, occurs in March. The average is barely 1 percent for the year. The favorite kinds appear to be leafhoppers, shield bugs, and stinkbugs. Black olive scales were found in 11 stomachs, and a second species, not identified, in 1.

Caterpillars are eaten sparingly in every month. The amount for the year is 3.26 percent, and the maximum consumption, 8.5 percent, occurs in March. Pupæ of the codling moth were found in 2 stomachs. Grasshoppers and crickets amount to 2.5 percent for the year. In July they aggregate nearly 16 percent, which is a remarkably small amount for such a confirmed ground feeder as the towhee. They are eaten rather irregularly from April to October inclusive, with a trace in January. The remainder of the animal food, consisting of a few flies and other insects, spiders, millipeds, and snails, amounts to a little more than one-half of 1 percent.

The following insects were identified in the stomachs:

COLEOPTERA.

Bradycellus rupestris.
Philonthus albionicus.
Tachyporus californicus.
Hypnoides ornatus.
Ptilinus ruficornis.
Aphodius rugifrons.
Aphodius rubidus.
Diabrotica soror.
Blapstinus pulverulentus.
Blapstinus rufipes.
Notoxus clamedæ.
Calandra oryza.

HEMIPTERA.

Saissetia oleæ.

LEPIDOPTERA.

Carpocapsa pomonella.

Vegetable food.—Fruit was eaten in every month from April to October inclusive, and also in December and January. The total for the year is 4.4 percent of the food. The greatest quantity was taken in June, when it amounted to 9.3 percent. Fruit, consisting of pulp and skins without seeds, was contained in 24 stomachs, Rubus fruits (blackberries or raspberries) in 28, cherries in 4, strawberries in 3, and elderberries in 41. Thus the towhee does no great damage to fruit—in fact, the fruit eaten is mostly wild or that which has been injured and left on the ground.

Grain is eaten regularly in every month and in a fair quantity. It amounts for the year to about 28 percent. The most is taken in fall and winter, though the variation is not very marked. August appears to be the month of greatest consumption, but it is doubtful if this would hold true if more stomachs were examined, as October

is about the same. June shows a higher percentage than either May or July, which indicates that some of the grain was gathered from the harvest field. Oats were the favorite kind, found in 140 stomachs. Barley was contained in 34, wheat in 16, and corn in 6. Sixteen stomachs were filled with grain alone, most of them with oats, but several with barley and one with corn.

The towhee is another of those species whose standard food is weed seed. It amounts to nearly 51 percent of the yearly diet. Even in June, the month of least consumption, it amounts to one-fifth of the food, while in December it reaches its maximum, 83.6 percent; but a good percentage is eaten in every month, no matter what other food is at hand.

Weed seed was found in 304 stomachs, and 46 contained nothing else. The quantity of this seed consumed by the towhees of California in one year must be enormous. The following are the species identified and the number of stomachs in which each was found:

Sunflower (*Helianthus* sp.)	1
Lesser tarweed (*Hemizonia fasciculata*)	7
Tarweed (*Madia sativa*)	34
Mayweed (*Anthemis cotula*)	6
Milk thistle (*Silybum marianum*)	1
Bur thistle (*Centaurea melitensis*)	39
Burweed (*Amsinckia tesselata*)	4
Nightshade (*Solanum nigrum*)	22
Plantain (*Plantago lanceolata*)	1
Lupine (*Lupinus* sp.)	19
Clover (*Trifolium* sp.)	9
Legumes not further identified	39
Turkey mullein (*Eremocarpos setigerus*)	5
Poison oak (*Rhus diversiloba*)	7
Alfilaria (*Erodium cicutarium*)	55
Geranium (*Geranium dissectum*)	1
Yellow sorrel (*Oxalis corniculata*)	4
Mustard (*Brassica nigra*)	10
Poppy (*Eschscholtzia californica*)	2
Miners' lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	4
Pigweed (*Chenopodium album*)	1
Rough pigweed (*Amaranthus retroflexus*)	77
Spurry (*Spergula arvensis*)	2
Chickweed (*Stellaria media*)	27
Catchfly (*Silene* sp.)	5
Knotweed (*Polygonum* sp.)	40
Sorrel (*Rumex acetosella*)	10
Brome grass (*Bromus* sp.)	5
Wild oats (*Avena fatua*)	33
Canary seed (*Phalaris canariensis*)	1
Panic grass (*Panicum* sp.)	1
Unidentified	77

Mast, in the shape of acorn meat, was taken to a slight extent. It reaches about one-half of 1 percent for the year. Vegetable rubbish aggregates 2.4 percent.

Food of young.—Among the 399 stomachs already discussed were those of 16 nestlings. They consisted of one brood of 3 about 2 days old; 3 broods, 9 in all, about 10 days old; and one brood of 4, probably 2 weeks old. The three youngest ones had been fed entirely on animal food, mostly grasshoppers, caterpillars, and spiders, with a few bugs. The 9 next in age had been fed animal matter to an average extent of 92 percent, to 8 percent of vegetable food. The animal food differs in proportions, not in constituents, from that taken by the adults. It is composed mainly of grasshoppers and caterpillars, with a few beetles, bugs, and wasps. The vegetable matter contains a little fruit, but the greater part is made up of wads or tangles of vegetable fibers. In one stomach the tangle consisted of horsehair. The same fact has been noted with the young of other species. The four that were 2 weeks old had been fed 95 percent of animal food and 5 percent of vegetable matter. The animal part is not so largely composed of grasshoppers, caterpillars, and spiders as with the younger birds, but beetles, wasps, and ants are more prominent. All of them contained remains of the beetle *Diabrotica soror* to an average extent of nearly 33 percent. Every one of these 4 stomachs contained a tangle of vegetable fibers, which constituted the whole of the vegetable food except one seed.

Some observations were made upon the feeding of nestlings of this species. It was found that the young are not fed as often as those of some other species, but probably get more at each feeding. The parent visiting the nest to feed the young gives food to all of them before leaving, and evidently regurgitates it from the gullet for this purpose. As the result of watching two nests for several hours, the maximum number of feedings in one hour was found to be 6, but from 2 to 4 was nearer the average. During the intervals between the feedings the parents could be seen hopping about on the ground and in the shrubbery searching for food, with which they appeared to gorge themselves, for caterpillars and other insects could be seen projecting from their bills. Both parents took part in the feeding, though when the nestlings were very young one bird stayed near or upon the nest until the other came, when they exchanged work.

SUMMARY.

The little animal food the California towhee eats is mostly of an injurious character. While eminently a ground feeder, it does not eat more of the predaceous ground beetles (Carabidæ) than other birds less terrestrial in their habits, and no more than a due proportion. In its vegetable food it probably does little, if any, damage. The amount of fruit eaten is small, and is mostly either damaged or wild. While it eats considerable grain, the great bulk is taken in the fall and winter months. Probably it does not visit the harvest fields much, for although a ground frequenter, it likes the presence of trees

and bushes. The service it performs in destroying the seeds of weeds should be sufficient to cover a number of sins, but fortunately there are none serious enough for consideration.

BLACK-HEADED GROSBEAK.

(*Zamelodia melanocephala.*)

During the six months from April to September inclusive, the black-headed grosbeak occurs throughout the State of California, excepting the arid deserts and boreal mountain summits. Like its eastern relative, the rose-breasted grosbeak, it takes readily to orchards and gardens, and is common in agricultural districts. It is a bird of beautiful plumage and sweet song, and is a welcome addition to the attractions of rural life. It often nests in orchard trees, and, as is perfectly natural, gets much of its food there. While this consists mainly of harmful insects, a goodly part of it is fruit. The grosbeak, as its name indicates, has a very powerful bill, and has no difficulty in cutting the skin of the firmest fruit. It feeds upon cherries, apricots, and similar fruits to a considerable extent, but on the other hand it habitually consumes some of the worst insect pests, such as the black olive scale, the 12-spotted diabrotica, and the codling moth. The destruction of this trio alone should entitle the bird to great consideration, but it eats also other destructive insects.

For the laboratory investigation of this bird's food 225 stomachs were accessible. They were collected in the six months from April to September inclusive, a fair number in each, except the last, when only 3 were obtained. These stomachs contained about 57 percent of animal matter to 43 of vegetable. The animal matter is composed of insects and spiders, with a few traces of vertebrates. Insects, such as beetles, scales, and caterpillars, constituted nearly 53 of the 57 percent of animal food.

Animal food.—Of the animal food, beetles are the largest item. They were found in 190 of the 225 stomachs. Of these, predatory ground beetles (Carabidæ) were found in 16 stomachs, and ladybird beetles (Coccinellidæ) in 2. To offset the destruction of these useful insects, the 12-spotted diabrotica, which often does serious injury to fruit trees, was found in 109 stomachs. Many weevils were found, and great numbers of several species of leaf beetles (Chrysomelidæ). To this family belongs the notorious Colorado potato beetle, which at one time seemed likely to ruin the potato industry of the East. The bird which attacked this pest constantly and systematically was the rose-breasted grosbeak, a near relative of the one under consideration. When the potato beetle finds its way into California, as eventually it undoubtedly will, the black-headed grosbeak is the bird most likely to become its active enemy.

Hymenoptera in the form of bees and wasps with a few ants aggregate less than 2 percent. A worker honeybee was found in one

stomach. Scale insects amount to 19.83 percent, or practically one-fifth of the whole food. Most of these were the black olive scale (*Saissetia oleæ*), but a few were the plum and prune scales (*Lecanium corni* and *L. pruinosum*). So persistently are scales eaten by this bird that they were found in 142 of the 225 stomachs, or 63 percent of all. While they did not entirely fill any stomach, in 26 they equaled or exceeded 50 percent of the contents. Hemiptera other than scales amount to a trifle over 1 percent.

Caterpillars, pupæ, and a few moths aggregate 7.7 percent. They were mostly eaten in April and May. Pupæ or larvæ of the codling moth were found in 26 stomachs, one stomach containing the remains of 29. Flies, grasshoppers, a few other insects, spiders, and miscellaneous creatures make up somewhat more than 1 percent. Eggshells were found in several stomachs and the bones of a small fish in one. The animal food of the grosbeak, it will be observed, is nearly all included in the 3 items, beetles, scales, and caterpillars. The other substances appear to be eaten merely as makeshifts.

Following are the insects identified in the stomachs of the grosbeak:

COLEOPTERA.

Platynus variolatus.
Rhizobius ventralis.
Psyllobora taedata.
Megapenthes elegans.
Buprestis fasciata.
Podabrus sp.
Telephorus consors.
Telephorus divisus.
Telephorus sp.
Aphodius rugifrons.
Aphodius sp.
Leptura militaris.
Syneta albida.
Gastroidea cyanea.
Gastroidea sp.
Lina scripta.
Diabrotica soror.
Diabrotica trivittata.
Blapstinus sp.
Deporaus glastinus.
Scythropus californicus.
Dorytomus hispidulus.
Baris sp.
Balaninus sp.

HEMIPTERA.

Saissetia oleæ.
Lecanium pruinosum.
Lecanium corni.

LEPIDOPTERA.

Carpocapsa pomonella.

HYMENOPTERA.

Apis mellifera. ♀

DIPTERA.

Borborus sp.

Vegetable food.—Cultivated fruit amounts to 23 percent of the grosbeak's food for the six months that it stays in the North. None was found in the stomachs taken in April, but in all other months there was a good percentage. Cherries appear to be the favorite fruit, as they were contained in 42 stomachs. Figs were identified in 24 stomachs, blackberries or raspberries in 23, strawberries in 2,

apricots in 1, and prunes in 1. Fruit pulp, not further identified, but probably of the larger kinds, was found in 25 stomachs. During cherry season these birds were almost constantly in the trees eating cherries. They do not appear to attack apricots, peaches, and prunes so extensively, but they feed freely on figs later in the season. Blackberries and raspberries are taken whenever possible, but mostly in July and August, after cherries are gone. There is no denying the fact that the grosbeak eats much fruit, and of the best kinds. Wild fruit amounts to something over 5 percent. All of it was eaten in the four months from May to August inclusive, but principally in July and August. The only wild fruit identified was the elderberry (*Sambucus*), which constitutes the bulk of this item, and was found in 26 stomachs.

Seeds of various weeds and some grain constitute 14.7 percent of the food. Oats were found in 9 stomachs and wheat in 7, but the amount was insignificant. The rest of the vegetable food consists of the seeds of more or less troublesome weeds, of which the grosbeak eats a very considerable quantity. The following is a list of the species identified and the number of stomachs in which each was found:

Milk thistle (*Silybum marianum*)	5
Nightshade (*Solanum nigrum*)	1
Bur clover (*Medicago lanceolata*)	2
Poison oak (*Rhus diversiloba*)	1
Sumac (*Rhus sp.*)	1
Alfilaria (*Erodium cicutarium*)	12
Geranium (*Geranium dissectum*)	13
Dwarf mallow (*Malva rotundifolia*)	1
Red maids (*Calandrinia menziesi*)	6
Rough pigweed (*Amaranthus retroflexus*)	3
Chickweed (*Stellaria media*)	13
Knotweed (*Polygonum sp.*)	2
Sorrel (*Rumex acetosella*)	1
Unidentified	24

Food of young.—Among these stomachs are those of 17 nestlings, varying in age from 2 to 8 days. The youngest brood, composed of 3, had been fed entirely on beetles, Hymenoptera, and caterpillars. For convenience, codling moth pupæ may be separated from other caterpillars. The average percentage of each was as follows: Beetles 0.7, Hymenoptera 0.7, caterpillars 92.3, codling moth pupæ 6.3. Note the large percentage of soft food in the shape of caterpillars and pupæ. Broods 2 and 3 were composed of 3 and 4 nestlings respectively, and were probably about 1 day older than brood 1. Their stomachs were entirely filled with animal food, divided as follows: Beetles 15 percent, caterpillars 55.4 percent, codling moth pupæ 23 percent, scales 2.6 percent, and other insects and spiders 4 percent. These nestlings had been fed with hard beetles to a much

greater extent than brood 1, although only 1 day older. Brood 4 was composed of 4 nestlings about a week old. They had been fed on animal matter to the extent of 96 percent to 4 percent of vegetable. The animal food was divided as follows: Beetles 67.6 percent, Hymenoptera 3 percent, caterpillars 2 percent, scales 20.7 percent, and eggshells 2.7 percent. The vegetable matter consisted of hulls of seeds and rubbish. The increase in beetles and other hard food and the decrease in caterpillars in the diet of this brood, as compared with the younger ones, is very marked. Brood 5 contained 3 young, estimated to be 8 days old. These had been fed entirely on animal food, made up of the following elements: Beetles 82 percent, Hymenoptera 10 percent, scales 6.3 percent, larvæ 3.3 percent, insects' eggs 1.7 percent, and spiders 2.7 percent. Another increase in the hard elements of the food over the last is seen here, although the difference in age is presumed to be only a day.

Observations were made upon the feeding of nestling grosbeaks, but the results are not remarkable. A nest of 3 young, estimated to be about 3 days old when first seen, was watched for one-hour periods for several days. The number of feedings varied from 2 to 4 per hour. In this respect the grosbeaks much resemble the California towhee. Like that bird they evidently collect a lot of food and then supply all the nestlings by regurgitation.

SUMMARY.

In summing up the economic status of the black-headed grosbeak, the fact that it eats a considerable quantity of orchard fruit can not be ignored. That this fruit is taken from the ripening crop on the tree is also true. This, however, is the sum total of the grosbeak's sinning. It eats but few useful insects and practically no grain. To offset its fruit eating, it eats habitually and freely the black olive scale, the codling moth, and the 12-spotted diabrotica, three pests of California fruit culture. Comparatively few complaints have been made against this bird by orchardists, and its depredations are not believed to be serious. Should it ever become so plentiful as to cause serious loss, no attempts should be made to destroy the bird, but attention should be directed to devices for protecting the fruit, thus leaving the bird to continue its good work in the destruction of insects. So active an enemy of insect pests as is this grosbeak can not well be spared, especially in view of the possibility of an invasion of the State by the Colorado potato beetle.[a]

[a] For further information on the food of the grosbeak, see Bull. 32, Biological Survey, Food Habits of Grosbeaks, by W. L. McAtee, 1908.

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